MACHINERY

DESIGN — CONSTRUCTION — OPERATION

Volume 38 OCTOBER, 1931 Number 2

PRINCIPAL ARTICLES IN THIS NUMBER

FOR COMPLETE CLASSIFIED CONTENTS, SEE PAGE 160-D

How Much Power Should Gears Transmit?—*By Earle Buckingham*..... 81
Drawing One-piece Hollow-walled Shells—*By J. E. Fenno*..... 88
The Part Grinding Plays in the Building of Lycoming Airplane Engines—*By Charles O. Herb*..... 91
The Electron Tube in Machine Design—*By Raymond Francis Yates*..... 95
Boston Exposition Shows Progress in Metallurgy 97
Editorial Comment..... 98
Helping to Bring the Business Ship into Port—Most Research Work Has Been Done by Large Plants—Too High a Price is Sometimes Paid for Accuracy
High-speed Die for Multi-slide Machine—*By F. C. Duston*..... 102
Stabilization of Business and Employment—*By Ralph E. Flanders*..... 106
Making 400 Welded Jigs per Month—*By J. R. Weaver*..... 108
Hydraulic Type Fixtures Speed up Diamond Boring—*By C. A. Birkebak*..... 112
What Effect Has Apprentice Training on Labor Turnover?—*By C. J. Freund*.. 121
Accurate Surface-grinding of Castings..... 122
A Free-wheeling Screw Press—*By Fred R. Daniels* 130
How Polishing Abrasives Have Been Improved—*By H. R. Power*..... 132
Laying out and Boring Accurately Spaced Holes—*By W. C. Betz*..... 136
Roll-feed Follow-die with Positive Knock-out—*By F. C. Mason*..... 139

DEPARTMENTS

Ingenious Mechanical Movements..... 99
Notes and Comment on Engineering Topics..... 110
Design of Tools and Fixtures..... 115
Special Tools and Devices for Railway Shops..... 124
Ideas for the Shop and Drafting-room..... 126
Questions and Answers..... 128
The Shop Executive and His Problems..... 134
New Shop Equipment..... 141

Total Distribution for September, 16,392 Copies

Product Index 188-206 Advertisers Index 209-210

PUBLISHED MONTHLY BY

THE INDUSTRIAL PRESS, 140-148 LAFAYETTE STREET, NEW YORK

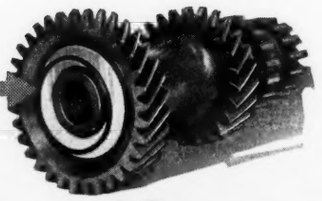
ROBERT B. LUCHARS, President EDGAR A. BECKER, Vice-pres. and Treasurer ERIK OBERG, Editor FRANKLIN D. JONES, Associate Editor
CHARLES O. HERB, FREEMAN C. DUSTON and JOSEPH E. FENNO, Assistant Editors
LONDON: 52-54 High Holborn PARIS: 15 Rue Bleue

YEARLY SUBSCRIPTION: United States and Canada, $3 (two years, $5); foreign countries, $6. Single copies, 35 cents.

Changes in address must be received by the fifteenth of the month to be effective for the forthcoming issue. Send old as well as new address.

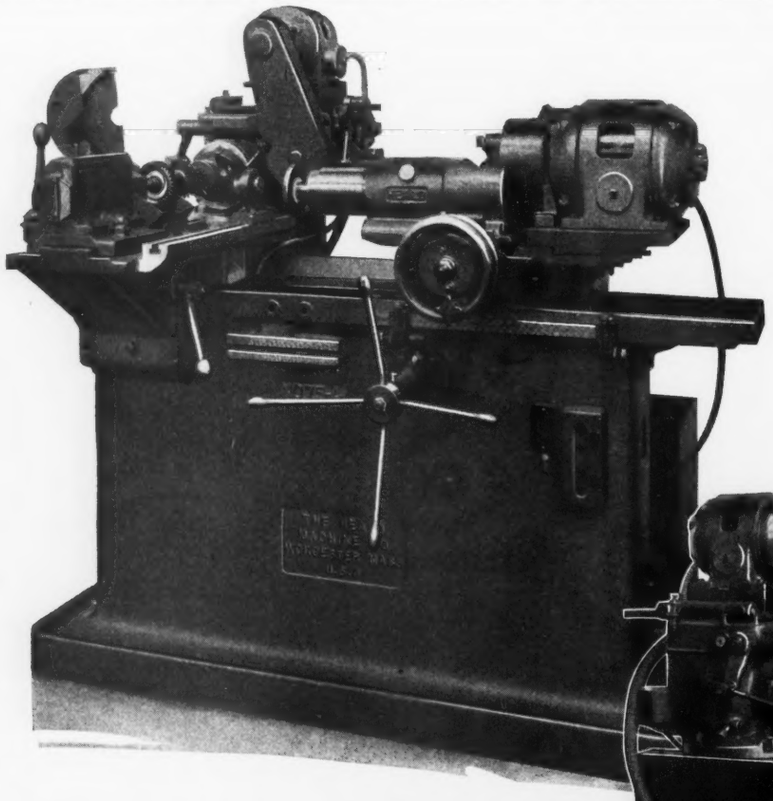
Copyright 1931 by The Industrial Press. Entered as second-class mail matter, September, 1894, at the Post Office in New York, N. Y., under the Act of March 3, 1879. Printed in the United States of America.

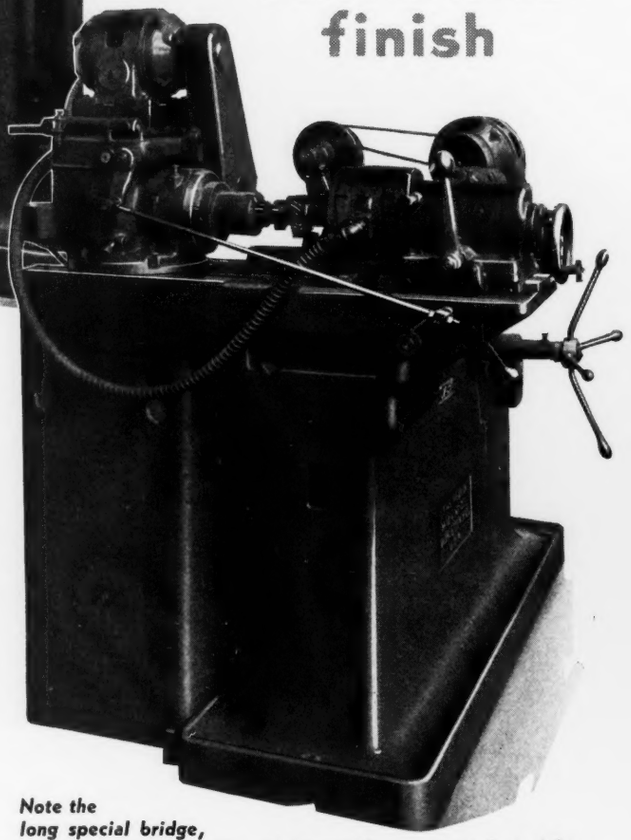
SURFACE GROUND



ON A HEALD INTERNAL

with accuracy and a perfect concentric finish





THE grinding of a hardened recessed surface on the end of a new transmission cluster gear constituted a particularly difficult problem until Heald solved it with the equipment shown in the accompanying views.

A Heald No. 75A Internal (hand reciprocation of table) was provided with a special bridge and supplementary base. A standard motor drive workhead, mounted at the rear of the bridge at right angles to the table, and a special tail stock carried the gear on centers with the grinding being performed with the periphery of a 5" wheel.

By turning the gear end for end on the centers, a second surface grinding operation was performed to bring the gear to correct overall length.

Perhaps your seemingly unsolvable problem can be licked with a Heald. Our engineers will be glad to study it and submit recommendations without obligation.

Note the long special bridge, the supplementary base, and the workhead mounted at right angles to the table ways.

The Heald Machine Company, Worcester, Massachusetts, U. S. A.

Branch Offices at Chicago, Cleveland, Detroit, New York, Philadelphia and Syracuse

HEALD

MACHINERY

Volume 38 NEW YORK, OCTOBER, 1931 Number 2

How Much Power Should Gears Transmit?

By EARLE BUCKINGHAM
Professor of Engineering Standards and Measurement
Massachusetts Institute of Technology

How Excessive Pressure on Gear Teeth Causes Pitting Due to Compressive Fatigue

THE amount of power that gearing *can* transmit and the amount it *should* transmit may vary widely. The former depends upon tooth strength alone, and the latter upon tooth durability as well as strength. In determining the allowable load-transmitting capacity of gearing, there are three general conditions to be considered. These are: (1) The limiting static tooth load or the strength of the tooth considered merely as a beam; (2) the maximum load capacity when intermeshing gears are rotating so that the effect of impact stresses must be taken into account; and (3) the maximum load capacity as limited by tooth wear.

It is evident that all gears, regardless of their function, must have teeth with sufficient beam strength to resist safely the applied loads. Gearing that is only rotated occasionally, possibly as part of an adjusting mechanism, could be designed merely with reference to the safe beam strength of the teeth; but when gearing is designed primarily for power transmission in connection with automotive and machine tool drives, speed reducers, etc., beam strength alone is not sufficient. For such ap-

plications it is essential to consider the effect of impact loads and also the load as it may be limited by tooth durability. The following information on this subject is the result of tests made at the Massachusetts Institute of Technology, extending over a period of six years. The results, as given in this article, are based upon a paper presented before the American Gear Manufacturers' Association. This information applies specifically to metallic spur gearing.

The Maximum Dynamic Load and its Relation to the Applied Load

In checking the load capacity of gearing by applying the following formulas, the maximum dynamic tooth load, the limiting static tooth load for beam strength, and the limiting static load for wear are all ascertained. Both the allowable dynamic load and the static load for wear must be less than the static load for beam strength. The relationship between these three conditions of loading will be shown later by an example from practice.

The maximum dynamic load for a given applied load and face width is affected by the pitch-line velocity and the modulus of elasticity of the material. The maximum dynamic load is the sum of the applied load and an additional or increment load resulting from the inertia of the masses and the variations in velocity set up by the action of the effective errors in the gear teeth. This maximum load is but momentary, but the teeth must be strong enough to resist it. All the equations that follow apply only to metal gears.

Errors in gear-tooth profiles, together with deformation of the profiles under load, cause the masses on the driving and driven shafts to change their velocities slightly. The change in momentum and velocity tends to cause the tooth surfaces to separate. This separation is resisted by the applied load. After separation, the surfaces of the teeth come together again with an impact. The additional or increment load set up by this impact depends primarily on the amount of change of momentum in the revolving masses caused by the effective errors in the gear-tooth profiles.

On metal gears, where the effective error is primarily the initial error in the gear-tooth profiles and the deformation under load is but a small part of the effective error, this increment load will not be directly proportional to the applied load but will be almost independent of it. On non-metallic gears, on the other hand, where the largest part of the effective error is the deformation under load, the increment load may be very nearly directly proportional to the applied load.

A complete detailed analysis of dynamic load phenomena is complex and requires various equations. For general use, however, it is often desirable to have simple equations that give a reasonably close approximation and are adapted to practical applications. The dynamic load formula that follows is a simplified one intended to meet practical requirements. This formula, however, is only intended for normal or average conditions. When

W = total applied tooth load, pounds;
T = width of gear face, inches;
f = applied load, pounds per inch of face;
V = pitch-line velocity, feet per minute;
I = increment load, pounds per inch of face (the formula for I is empirical and based upon tests);
f_2 = load, in pounds per inch of face, required to deform teeth the amount of the effective error;
C = tabulated value representing load required to deform tooth of given material and form a given amount (see Table 1); and
W_d = total maximum dynamic tooth load, pounds.

Then

$$f_2 = f + C \qquad (1)$$

$$f = \frac{W}{T} \qquad (2)$$

$$I = \frac{0.05\,V f_2}{0.05\,V + \sqrt{f_2}} \qquad (3)$$

Table 1. Values of C Used in Determining Dynamic Tooth Loads

Materials	Tooth Form	Measured Tooth-action Error, Inch*			
		0.0005	0.001	0.002	0.003
		Values of C			
Cast iron and cast iron	14 1/2-degree involute	400	800	1600	2400
Cast iron and cast iron	20-degree full depth	415	830	1660	2490
Cast iron and cast iron	20-degree stub	430	860	1720	2580
Cast iron and steel	14 1/2-degree involute	550	1100	2200	3300
Cast iron and steel	20-degree full depth	570	1140	2280	3420
Cast iron and steel	20-degree stub	590	1180	2360	3540
Steel and steel	14 1/2-degree involute	800	1600	3200	4800
Steel and steel	20-degree full depth	830	1660	3320	4980
Steel and steel	20-degree stub	860	1720	3440	5160

*This measured error is the maximum relative displacement of two gears, measured on the pitch line. Thus if one gear had a spacing error of + 0.001 and its mate had a similar error of — 0.001, the measured error would be 0.002. Again, if one gear had an error of 0.002 and its mate was perfect, the measured error would be 0.002 also. The noise of operation gives a remarkably consistent qualitative measure of the extent of the error. Gears noisier than the average will have greater errors than the average.

Table 2. Values of I Used in Determining Dynamic Tooth Loads

Pitch-line Velocity V	Values of f_2											
	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000
	Values of I											
100	91	137	172	201	227	251	273	293	312	330	347	364
200	155	240	308	365	417	463	506	546	584	619	653	686
300	201	322	419	502	577	645	708	767	822	875	925	973
400	236	387	511	618	714	802	884	961	1034	1102	1168	1231
500	264	442	588	717	833	940	1040	1133	1222	1306	1386	1464
600	286	487	655	803	938	1062	1178	1287	1391	1489	1584	1675
800	321	558	762	944	1111	1266	1412	1550	1669	1806	1927	2043
1000	346	613	845	1056	1250	1432	1603	1766	1922	2071	2215	2354
1200	364	655	912	1146	1364	1568	1765	1947	2125	2295	2460	2619
1400	379	689	966	1220	1458	1683	1897	2101	2298	2487	2671	2848
1600	391	717	1010	1283	1538	1781	2012	2234	2448	2654	2854	3048
2000	409	760	1081	1382	1667	1938	2199	2450	2759	2929	3158	3381
2500	424	798	1145	1473	1786	2086	2376	2656	2928	3193	3452	3704
3000	435	826	1192	1541	1875	2198	2510	2813	3109	3398	3680	3957
3500	443	847	1228	1593	1944	2285	2616	2938	3253	3561	3863	4159
4000	450	863	1257	1635	2000	2355	2701	3039	3370	3694	4012	4325
4500	455	877	1280	1668	2045	2413	2771	3122	3466	3804	4136	4463
5000	459	888	1299	1697	2083	2461	2830	3192	3548	3898	4242	4581

$$W_d = T\ (f + I) \qquad (4)$$

The value of C will vary in direct proportion to the extent of the measured error. As the modulus of elasticity of cast iron and bronze are nearly alike, the values of C given in Table 1 for cast iron can also be used for bronze.

In order to simplify the use of this material still further, Table 2 has been prepared which gives the values of I for pitch-line velocities up to 5000 feet per minute corresponding to values f_2 up to 6000 pounds. Thus, for any given combination of materials with any known error, the value of f_2 is determined by adding the corresponding value of C from Table 1 to the amount of the transmitted load per inch of face. Then the value of I for the specified pitch-line velocity will be found from Table 2 in the column headed by the predetermined value of f_2.

Equation (4) gives a close approximation of the intensity of the maximum instantaneous dynamic load.

The Beam Strength of the Teeth

Some measure of the beam strength of the gear teeth is required to insure that they will be strong enough to withstand the dynamic load without breaking. For this purpose, the Lewis formula (arranged for diametral pitch) will be used, and the elastic limit of the material will be substituted for the safe working stress, which is the value commonly employed. When

W_s = limiting static tooth load for beam strength, pounds;
S = elastic limit of material, pounds per square inch;
P = diametral pitch of teeth, inches;

An Example of Surface Fatigue — the Surface of a Machine Steel Roll Crumbling under Effect of Heavy Pressure

Table 3. Static Beam Strength (Ws) for 1 Diametral Pitch, 1-inch Face Width and 14 1/2-degree Tooth Form

Number of Teeth	Cast Iron	Semi-steel and Bronze	Cast Steel	SAE 1030 Steel	SAE 1045 Steel	SAE 3245 Steel
	Elastic Limit (S) of Material					
	24,000	36,000	45,000	60,000	90,000	120,000
12	5,160	7,740	9,675	12,900	19,350	25,800
13	5,354	8,031	10,040	13,386	20,079	26,772
14	5,654	8,482	10,602	14,136	21,204	28,272
15	5,880	8,820	11,025	14,700	22,050	29,400
16	6,108	9,162	11,452	15,270	22,905	30,540
17	6,333	9,500	11,875	15,834	23,751	31,668
18	6,484	9,727	12,159	16,212	24,318	32,424
19	6,636	9,954	12,442	16,590	24,885	33,180
20	6,784	10,177	12,721	16,962	25,443	33,924
21	6,936	10,404	13,005	17,340	26,010	34,680
23	7,087	10,630	13,288	17,718	26,577	35,436
25	7,312	10,969	13,711	18,282	27,423	36,564
27	7,464	11,196	13,995	18,660	27,990	37,320
30	7,615	11,422	14,278	19,038	28,557	38,076
34	7,840	11,761	14,701	19,602	29,403	39,204
38	7,992	11,988	14,985	19,980	29,970	39,960
43	8,143	12,214	15,268	20,358	30,537	40,716
50	8,294	12,441	15,552	20,736	31,104	41,472
60	8,520	12,780	15,975	21,300	31,950	42,600
75	8,671	13,006	16,258	21,678	32,517	43,356
100	8,822	13,233	16,542	22,056	33,084	44,112
150	8,973	13,464	16,825	22,434	33,651	44,868
300	9,199	13,798	17,248	22,998	34,497	45,996
Rack	9,350	14,025	17,532	23,376	35,064	46,752

Table 4. Static Beam Strength (Ws) for 1 Diametral Pitch, 1-inch Face Width and 20-degree Full-depth Tooth Form

Number of Teeth	Cast Iron	Semi-steel and Bronze	Cast Steel	SAE 1030 Steel	SAE 1045 Steel	SAE 3245 Steel
	Elastic Limit (S) of Material					
	24,000	36,000	45,000	60,000	90,000	120,000
12	5,880	8,820	11,025	14,700	22,050	29,400
13	6,259	9,388	11,736	15,648	23,472	31,296
14	6,636	9,954	12,442	16,590	24,885	33,180
15	6,936	10,404	13,005	17,340	26,010	34,680
16	7,087	10,630	13,288	17,718	26,577	35,436
17	7,238	10,857	13,572	18,096	27,144	36,192
18	7,389	11,084	13,855	18,474	27,711	36,948
19	7,540	11,311	14,139	18,852	28,278	37,704
20	7,689	11,534	14,418	19,224	28,836	38,448
21	7,840	11,761	14,701	19,602	29,403	39,204
23	7,992	11,988	14,985	19,980	29,970	39,960
25	8,143	12,214	15,268	20,358	30,537	40,716
27	8,368	12,553	15,691	20,922	31,383	41,844
30	8,594	12,891	16,114	21,486	32,229	42,972
34	8,896	13,345	16,681	22,242	33,363	44,484
38	9,199	13,798	17,248	22,998	34,497	45,996
43	9,499	14,248	17,811	23,748	35,622	47,496
50	9,801	14,702	18,378	24,504	36,756	49,008
60	10,104	15,156	18,945	25,260	37,890	50,520
75	10,404	15,606	19,507	26,010	39,015	52,020
100	10,706	16,059	20,074	26,766	40,149	53,532
150	11,008	16,513	20,641	27,522	41,283	55,044
300	11,308	16,963	21,204	28,272	42,408	56,544
Rack	11,611	17,416	21,771	29,028	43,542	58,056

T = width of face of gear, inches; and
Y = tooth form factor (see page 640 of MACHINERY'S HANDBOOK)

$$W_s = \frac{STY}{P} \qquad (5)$$

The static beam strength may readily be determined from Tables 3, 4, and 5, which give the static beam strength of 1 diametral pitch gears of 1-inch face for the three most commonly used gear-tooth systems. The values in these tables should be multiplied by the width of face, in inches, and divided by the diametral pitch.

Equation for Load Capacity as Limited by Wear

Some measure of the durability of the surfaces of the gear teeth is also required to avoid excessive wear. For this purpose we can use the following equations and values: When

W_w = limiting static tooth load for wear, pounds;
D = pitch diameter of pinion, inches;
T = width of face, inches;
Q = ratio factor as determined by Equation (6);
K = load-stress factor;
n = number of teeth in pinion;
N = number of teeth in gear;
E_1 and E_2 = modulus of elasticity of material in pinion and gear, respectively;
S_f = compressive fatigue limit stress for material, pounds per square inch; and
A = pressure angle of tooth form.

Then

$$Q = \frac{2N}{n + N} \qquad (6)$$

$$K = \frac{S_f^2 \sin A}{1.4}\left(\frac{1}{E_1} + \frac{1}{E_2}\right) \qquad (7)$$

$$W_w = DTKQ \qquad (8)$$

In order to simplify the use of this material, Table 6 has been prepared, which gives values for K corresponding to the probable fatigue limit stress for the materials. For the sake of simplicity, a pressure angle of 14 1/2 degrees has been employed in computing these tabulated values.

This table is quite incomplete and covers only materials actually tested. Tests now being made on steel similar to S A E 6150, heat-treated to about 300 Brinell before machining, indicate that the fatigue limit in compression is about 145,000 pounds per square inch and the corresponding value of K is equal to about 350. Eventually the plan is to obtain a more complete list of compressive fatigue limits for various steels and heat-treatments; hence, Table 6 should be consid-

ered as tentative and subject to additions and corrections.

Example Showing Comparison of Dynamic Load and Static Beam Strength

To illustrate the application of these formulas, a pair of spur gears used on a certain machine will be taken as an example. The data for this gearing is as follows: 8 diametral pitch; pressure angle, 14 1/2 degrees; face width, 1.25 inches; number of teeth in the pinion and gear, 33 and 59, respectively; pitch-line velocity, about 300 feet per minute; tooth load, about 400 pounds.

Originally these gears were of semi-steel and had operated satisfactorily for several years; then they were replaced with unheat-treated machine-steel gears (the material being about the same as S A E steel 1045), and in about eight weeks they were worn so badly as to be practically worthless.

The extent of the error to be expected on well cut gears of this size is about 0.002 inch. Using this value as a measure of their accuracy, the dynamic load will be determined for the original semi-steel gears from Equation (2), as follows:

$$f' = \frac{400}{1.25} = 320$$

From Table 1 (considering semi-steel as cast iron) we find that $C = 1600$. Then from Equation (1),

$$f_2 = 320 + 1600 = 1920$$

The value of I is obtained from Table 2; thus, for a velocity $V = 300$ and a value $f_2 = 2000$, Table 2 shows that $I = 500$. Then, from Equation (4),

$$W_d = 1.25\ (320 + 500) = 1025 \text{ pounds}$$

Table 3 gives the static beam strength of a 33-tooth semi-steel pinion of 1 diametral pitch and 1-inch face as 11,700, approximately; hence,

$$W_s = \frac{11{,}700 \times 1.25}{8} = 1828 \text{ pounds}$$

The difference between the values of W_s and W_d represents a margin of safety of 800 pounds, which is double the applied load. The factor of safety would be equal to 1.78; this seems low according to our usual ideas, but it has proved to be ample in this case.

Checking the Load with Reference to Wear

As the relationship between the static beam strength and dynamic load is satisfactory, this drive will now be checked with reference to wearing conditions. For the solution of Equations (6) and (8) we have the following: $D = 4.125$; $T = 1.250$; $n = 33$; and $N = 59$. Substituting the given values in Equation (6),

Table 5. Static Beam Strength (Ws) for 1 Diametral Pitch, 1-inch Face Width and 20-degree American Standard Stub Tooth Form

Number of Teeth	Cast Iron	Semi-steel and Bronze	Cast Steel	SAE 1030 Steel	SAE 1045 Steel	SAE 3245 Steel
	Elastic Limit (S) of Material					
	24,000	36,000	45,000	60,000	90,000	120,000
12	7,464	11,196	13,995	18,660	27,990	37,320
13	7,776	11,649	14,562	19,416	29,124	38,832
14	8,143	12,214	15,268	20,358	30,537	40,716
15	8,368	12,553	15,691	20,922	31,386	41,844
16	8,671	13,006	16,258	21,678	32,517	43,356
17	8,822	13,233	16,542	22,056	33,084	44,112
18	9,048	13,572	16,965	22,620	33,930	45,240
19	9,275	13,910	17,388	23,184	34,776	46,368
20	9,424	14,137	17,671	23,562	35,343	47,124
21	9,576	14,364	17,955	23,940	35,910	47,880
23	9,801	14,702	18,378	24,504	36,756	49,008
25	10,027	15,040	18,801	25,068	37,602	50,136
27	10,255	15,382	19,228	25,638	38,457	51,276
30	10,480	15,721	19,651	26,202	39,303	52,404
34	10,706	16,059	20,074	26,766	40,149	53,532
38	10,932	16,398	20,497	27,330	40,995	54,660
43	11,083	16,624	20,781	27,708	41,562	55,416
50	11,385	17,078	21,348	28,464	42,696	56,928
60	11,611	17,416	21,771	29,028	43,542	58,056
75	11,913	17,870	22,338	29,784	44,676	59,568
100	12,139	18,208	22,761	30,348	45,522	60,696
150	12,441	18,662	23,328	31,104	46,656	62,208
300	12,818	19,227	24,034	32,046	48,069	64,092
Rack	13,193	19,792	24,741	32,988	49,482	65,976

Table 6. Load-stress Factors K

Materials	Assumed Fatigue Limit in Compression, Pounds per Square Inch	Maximum Specific Compressive Stress	K
Cast steel and cast steel	60,000 60,000	60,000	43
Forged steel and cast steel	80,000 60,000	65,000	50
Forged steel and forged steel	80,000 80,000	80,000	76
Hardened steel and cast steel	220,000 60,000	90,000	96
Forged steel and semi-steel	80,000 90,000	80,000	114
Hardened steel and phosphor bronze	220,000 70,000	85,000	135
Hardened steel and semi-steel	220,000 90,000	90,000	145
Heat-treated steel and heat-treated steel	120,000 120,000	120,000	171
Semi-steel and semi-steel	90,000 90,000	90,000	193
Hardened steel and heat-treated steel	220,000 120,000	130,000	201
Hardened steel and hardened steel	220,000 220,000	220,000	576

These figures represent the limiting load conditions and make allowance for the cold-working received by the gears in operation. The dynamic loads should be such that somewhat lower values are used, depending upon the margin of safety required for any specific application. These figures are also based upon smooth tooth surfaces.

$$Q = \frac{118}{92} = 1.282$$

Table 6 shows that $K = 193$. Then, from Equation (8),

$$W_w = 4.125 \times 1.25 \times 193 \times 1.282 = 1276$$

This last value, which represents the limiting load for wear, is about 250 pounds greater than the dynamic load. In other words, we have a margin of safety of 250 pounds, which seems somewhat small, but has proved to be sufficient in service.

Why the Machine-Steel Gears Failed Due to Excessive Wear

We will next compute, in a similar manner, the dynamic load conditions on the machine-steel gears previously referred to. The values $f = 320$, $V = 300$, and $T = 1.25$ are the same as in the preceding example. From Table 1 we find that $C = 3200$; hence, from Equation (1),

$$f_2 = 320 + 3200 = 3520$$

Table 2 shows that $I = 710$. Then, from Equation (4),

$$W_d = 1.25\ (320 + 710) = 1288 \text{ pounds}$$

Table 3 shows that the static beam strength of the 33-tooth machine-steel pinion (S A E 1045) is about 29,100; hence,

$$W_s = \frac{29{,}100 \times 1.25}{8} = 4547 \text{ pounds}$$

In this case, the margin of safety for beam strength is about 3250 pounds, and the factor of safety, 3.53.

The trouble with these machine-steel gears, however, is excessive wear rather than tooth breakage; consequently, Equation (8) will be applied to check the load conditions with reference to wear. The values of D, T, and Q are the same as before; thus, $D = 4.125$, $T = 1.250$, and $Q = 1.282$.

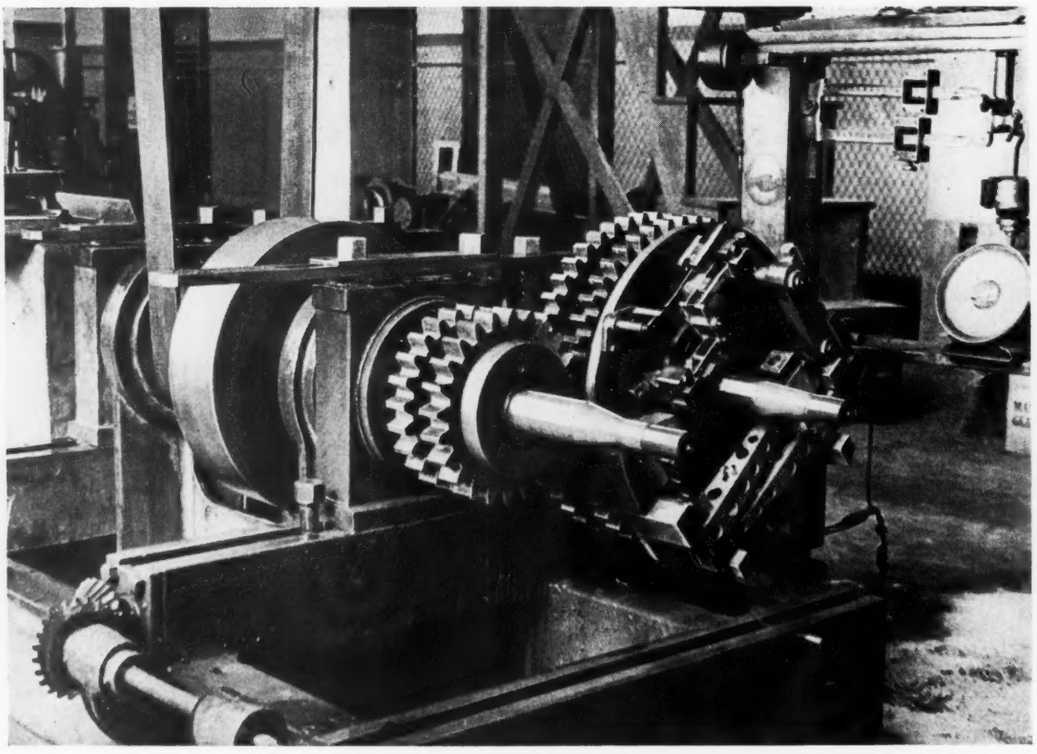
From Equation (7), using a value of S_f equal to 90,000 pounds per square inch, and a modulus of elasticity E_1 and E_2 of 30,000,000, $K = 96$.

Inserting these values in Equation (8), it will be found that $W_w = 635$ pounds. In this case, the limiting load for wear is less than one-half the dynamic load; hence, the rapid wear which occurred was to be expected.

Relation Between Dynamic and Applied Loads

Heretofore, the dynamic loads have generally been considered as being directly proportional to the applied loads. Thus certain velocity factors have been established by running mechanical elements, such as cast-iron gears, to destruction under varying speeds and loads. The applied loads that cause failure have then been divided by the static load that would cause a similar failure, and the quotients thus obtained have been used as velocity factors.

The Charting Mechanism of Lewis Gear Testing Machine. The Gear Research that Forms the Basis for the Conclusions in this Article was Carried out by the Aid of the Machine Illustrated



For example, if a pair of cast-iron gears running at a certain pitch-line velocity should fail under a transmitted load of 1000 pounds, and if the same gears failed under a static load of 3000 pounds, the velocity factor for this speed would be taken as one-third. It is then assumed that, under the same velocity conditions, the dynamic load would be equal to three times the applied load, so that with an applied load of 250 pounds the dynamic load would be equivalent to 750 pounds.

In practice, this velocity factor has been used to reduce the safe working stress of the material by multiplying the safe static stress, which includes a liberal factor of safety, by the velocity factor. For the determination of this velocity factor, the Barth equation $\left(\frac{600}{600 + V}\right)$ or some modification of it has been generally used.

In the case of metal gears, however, the dynamic loads are not directly proportional to the applied loads, and hence the use of velocity factors in such cases is incorrect and misleading.

The foregoing simple method of approximating the intensity of the dynamic loads on spur gear teeth is primarily the result of suggestions of Carl G. Barth. As mentioned previously, this approximate equation is intended for normal or average conditions. An exceptional condition should receive special consideration.

For example, where gears are to be used for an airplane propeller drive, and the weight of the gear blanks has been reduced to a minimum, the mass conditions will be much below the average, and the use of these general equations may give increment load values somewhat larger than the actual ones. On the other hand, if the gear is very large and the gear blank is also to act as a flywheel, the mass conditions may be much greater than the average, and these general equations may give increment load values somewhat smaller than the actual ones.

* * *

Amateur Movies for Industrial Use

Today it is as simple to make good movies with an amateur camera as it is to make clear snapshots with a box camera. Furthermore, the cost of making amateur movies is comparatively small.

Amateur Movie Equipment Enables Pictures to be Made for Recording Practice as an Aid in Training Employes

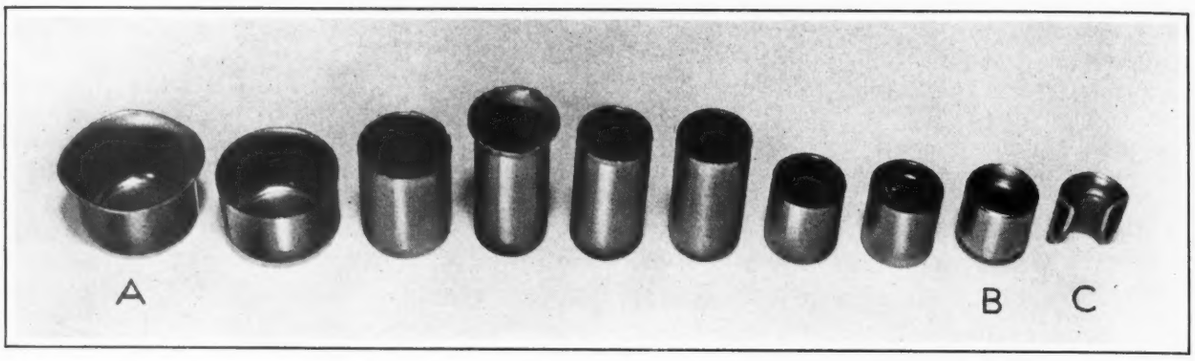
The amateur motion picture has attracted attention in industry because of opportunities offered for its practical application. Compact portable equipment for making 16-millimeter movie films now makes it possible to record the action of a machine or a worker at close range without interfering with manufacturing processes or interrupting the worker. Slow-motion pictures can be made for studying processes minutely.

Many industrial operations are performed at such speed that the eye cannot follow them. The slow-motion picture makes it possible to study an operation, the exact nature of which might otherwise never be fully known. An interesting example of this recently came to the attention of the Eastman Kodak Co. A girl, very efficient in assembly work, performed a certain operation entirely with her left hand, while less efficient workers used both hands. The girl explained her method many times, but still her co-workers could not equal her performance. A slow-motion picture revealed a movement of one of her fingers which was essential to her efficiency, but of which she herself was unaware.

Another example of the use of the industrial movie is of interest. An American firm had developed a method of manufacture that was particularly efficient. In attempting to transmit the information about the method by mail to an English subsidiary, a description and drawings were sent. However, it was found difficult to present the subject in such a manner that the English company could make use of it. Then a 100-foot 16-millimeter film was made by one of the men in the plant and sent abroad. The film cleared up all points in doubt.

Sometimes a small movie camera, operating automatically, can be placed in a position that would be unsafe for a human observer. In this way, facts can be recorded that otherwise could not be properly noted. For example, a movie camera mounted on the top of the wing of an airplane has been used to examine the action of the elevators and rudder during flight.

Industrial concerns with branches have found movies helpful in disseminating information to their distant offices. Motion pictures also provide an excellent method for teaching employes the principles of safety.



Drawing One-Piece Hollow-Walled Shells

Remarkable Ingenuity is Displayed in the Design of a Die that Literally Turns the Shell Inside Out to Form the Double Wall

By J. E. FENNO

OF the many unusual dial press jobs that have come to the writer's attention in the past, the most outstanding, from the viewpoint of simplicity and ingenuity of die design, is the production of the hollow-walled shell shown at *B* in the heading illustration. An idea of the intricate shape of this shell will be obtained from the view at *C*, where the shell is shown sawed in two. Formerly, these shells—known as conduit units—were made from bar stock in a screw machine. With the present method, however, the cost of manufacture has been reduced 60 per cent, and only two sets of press tools are required to maintain a production of 2700 parts per hour.

The shells are made from strips of dead soft cold-rolled steel, about 1/32 inch thick. At one end of the shell is a spherical depression, the other end being rounded. Both of these spherical surfaces must be very accurately formed. The units are used to transmit movement to four-wheel automobile brakes. A number of them are strung upon a wire cable, so that the spherical depression in each part engages the rounded end in the next part, thus forming a flexible shaft for transmitting the required movement to the brake.

Two presses are used for completing the units, both presses and dies employed being built by the V & O Press Co., Hudson, N. Y. In the first operation (not illustrated) the strip is fed to the die by an ordinary automatic roll feed. In this die the part is blanked and the first drawing operation is performed, as indicated at *A* in the heading illustration. These shells are then taken to the dial press shown in Fig. 1, where they are trimmed, drawn, pierced, and formed to their final shape, in eight stages. All that is required of the operator is to keep the chute filled with the shells.

The various stages are clearly shown in Fig. 2. Here, at Stage 1 the shell is shown in position in the stationary die *A* after it has left the chute. As the punch

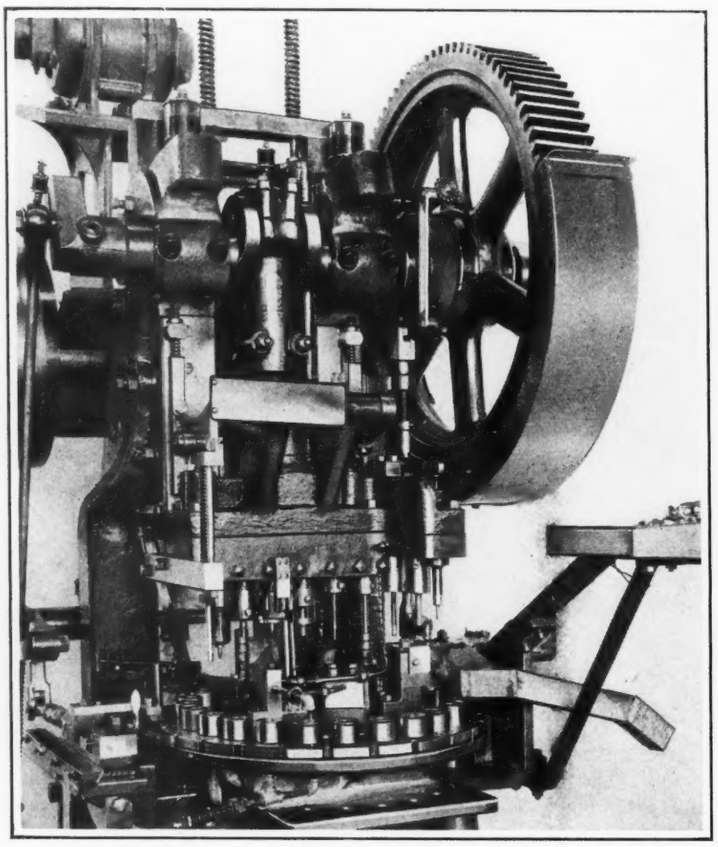


Fig. 1. Eight-stage Dial Press that Performs the Operations Indicated in the Heading Illustration

descends, the flange left in the preceding operation is pinched off by the renewable punch ring *B*. Upon the continued descent of the punch, the trimmed shell is carried down into a clearance hole in the upper end of one of the bushings *C* in the dial.

In each of the dial bushings are two drawing dies, the larger of which is at the top, as indicated at *D* in the second stage. One advantage of this arrangement is that the gripping action of the shell in the lower die serves to hold the shell securely in position for all the subsequent operations.

After the flange has been pinched off at Stage 1, the shell is deposited on top of the larger drawing die by the punch as it reaches its lowest position. Now, as the punch ascends and leaves the shell, the dial is indexed, carrying both bushing and shell to the next station, shown at Stage 2. Upon the descent of the punch *E*, the diameter of the shell is reduced as it is carried to the bottom of the upper die *D*. The press ram then ascends and the dial is once more indexed, carrying the shell to the succeeding station, indicated at Stage 3. Here, the diameter of the shell is again reduced as it is forced to the bottom of the lower die by the punch *F*. This is the final straight draw; consequently, a flange is left on the shell to allow it to be trimmed to the required length.

At the next station this flange is pinched off by the renewable ring *G* in the same manner as at Stage 1. At the fifth stage, a hole is pierced in the bottom of the shell. It will be noted here that the punch is in the lower member, the piercing being forced upward through a hole in the die *H*. A cross-hole (not shown) in the upper end of die *H*, is provided for ejecting these piercings. Pad *J*, supported by means of a buffer beneath the press table, allows member *H* to move downward enough to permit the punch to enter and pierce the shell.

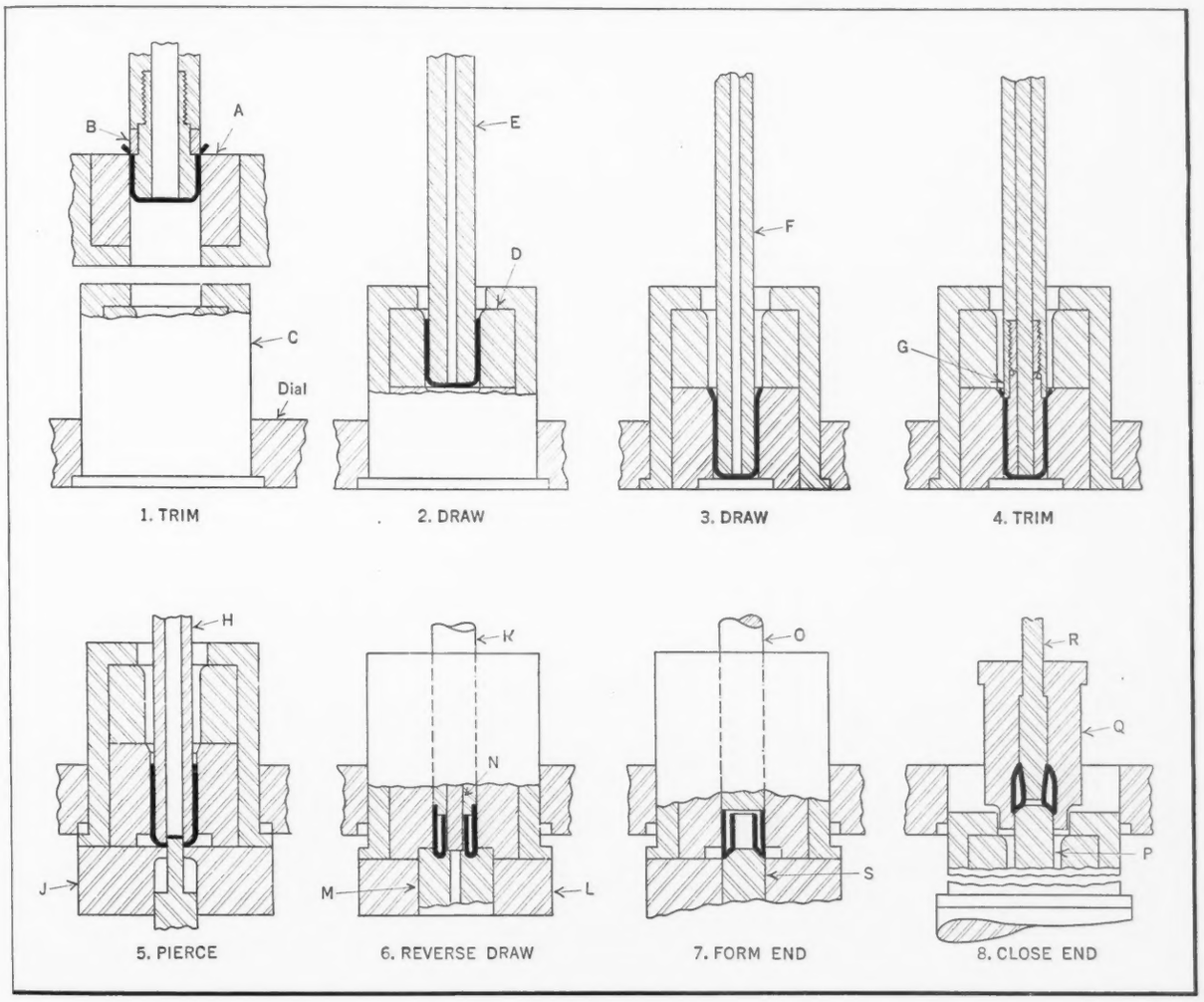


Fig. 2. Successive Operations in Producing a Double-walled Shell in a Dial Press

At Stage 6, what might be termed a reverse drawing operation is performed on the shell to form the double wall. The action of the die is similar to that of a curling or wiring die. When the punch *K* descends, the bushing ring-dies and shell are carried down against the pressure-pad *L*. As this downward movement continues, the bottom of the shell enters the circular groove in the end of

die M and curls the shell around the pin N, as indicated in the illustration.

Forming the Spherical Surfaces

The spherical depression in the bottom of the shell is produced at Stage 7. Under the action of the punch O, the bushing ring-dies and shell are carried downward until the end of the shell, coming into contact with punch S, assumes a spherical shape.

At the final station (Stage 8) the two cylindrical ends at the upper part of the shell are joined to form a spherical surface having a radius equal to the spherical depression at the bottom of the shell. At this station the punch P is stationary, and as the press ram descends, the drawing die Q forces the dial bushing downward, causing the shell to pass through the ring-dies to the upper end of the bushing, where the shell enters the die Q. As the ram continues to descend, the upper end of the shell is forced inward against the spring pin R until the required spherical shape is produced. Spring pin R also serves as an ejector for the completed shell upon the ascent of the ram.

In addition to the ejecting arrangement mentioned, compressed air is also employed to aid in ejecting both the completed part and the trimmings. As a safety measure, and to prevent damage to the die, the press is equipped with a device that prevents the engagement of the clutch unless the dial bushings are in correct alignment with the punches. Moreover, should a completed part become stuck in a bushing or fail to be ejected after the final stage, a spring-actuated plunger, which enters each bushing successively, will be raised when it comes in contact with the part left in the bushing and will disengage the clutch, thus stopping the press.

Instead of using oil as a drawing lubricant, a device operated by compressed air is provided, which blows precipitated chalk into the ring-dies before the dies come into their loading position.

Production Formula for Offset Milling

By CHARLES D. OESTERLEIN

The formula given below makes it possible to estimate the production that can be obtained on a given job by the offset milling method. In this formula

P = production, in number of parts per hour;
F = feed, in inches per minute;
N = number of work-holding units in fixture;
D = depth of cut, in inches.

Then,

$$P = 10 \times \frac{F \times N}{D}$$

Example—If, in a certain case, the feed equals 6 inches per minute and there are six work-holding units in the fixture, then, if the depth of cut is 1 inch, we find:

$$P = 10 \times \frac{6 \times 6}{1} = 360$$

It is of interest to note the effect on production of the number of work-holding units without any change in the feed used. Take the same example as given above and it will be seen that for a 4-unit fixture the production is

$$P = 10 \times \frac{6 \times 4}{1} = 240$$

For an 8-unit fixture the production would be

$$P = 10 \times \frac{6 \times 8}{1} = 480$$

For a 12-unit fixture the production would be

$$P = 10 \times \frac{6 \times 12}{1} = 720$$

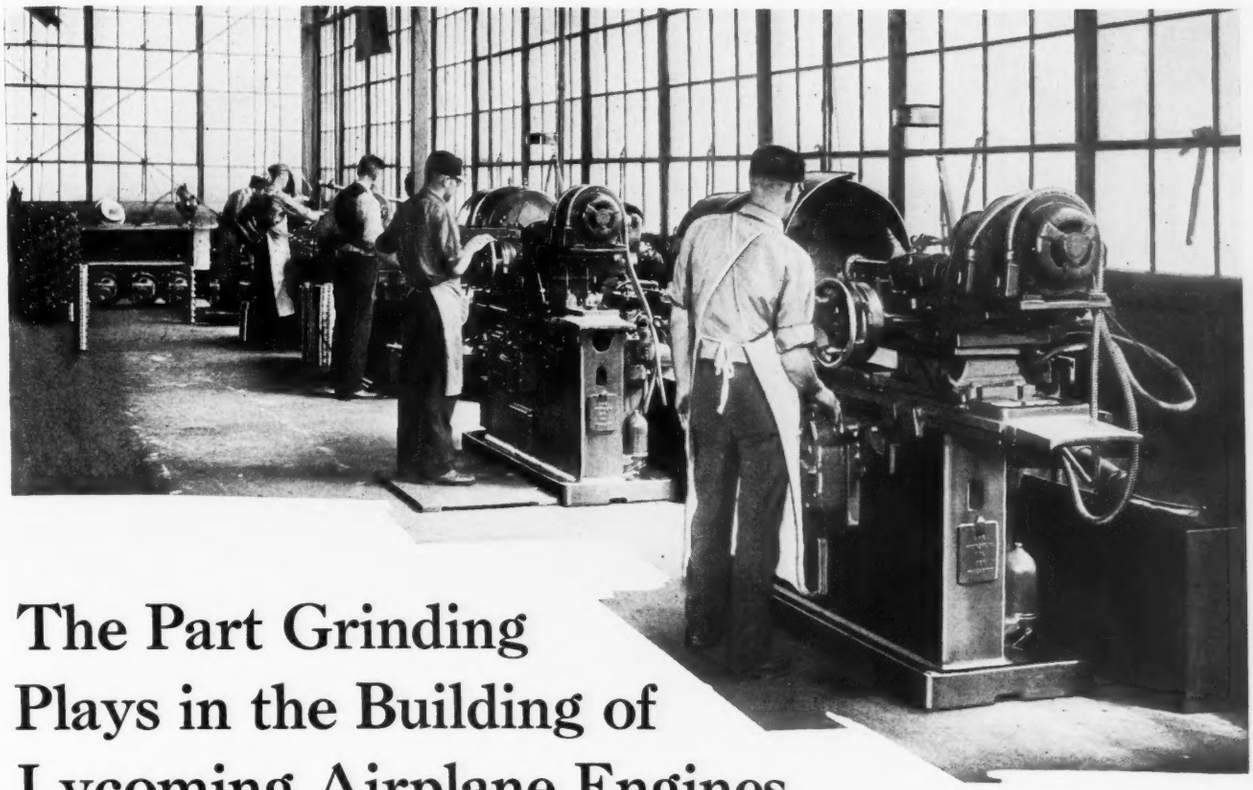
To estimate how many work-holding units are required for a given production, the formula may be transposed. For example, if 300 parts are wanted per hour, with a feed of 6 inches per minute and a depth of cut of 1 inch, then

$$N = \frac{P \times D}{10 \times F} = \frac{300 \times 1}{10 \times 6} = 5$$

In many instances the problem is, "How many parts can the operator handle?" This will depend largely upon the size of the parts and their contour and the design of the fixture. Roughly speaking, the larger the piece the slower the handling. Symmetrical parts weighing a few ounces, in which only the loading is done by the operator, the parts being ejected automatically, are being handled at rates ranging from 2000 to 3000 per hour. If the operator must unload as well as load the fixture, that is, handle each part twice, only half this number would be possible. If he must also look at the part carefully because of a possibility of error in loading, then another 15 to 30 per cent reduction must be expected, and somewhere around 900 to 950 parts per hour may be the top limit. Parts weighing from half a pound to a pound can be handled at the rate of 750 parts per hour on an automatic fixture and at about from 300 to 450 parts per hour on a hand clamping fixture.

* * *

Foreign sales of industrial machinery during July, the last month for which complete statistics are available, amounted to $11,118,000. Of this, metal-working machinery accounted for $2,778,000. The exports of metal-working machinery for the corresponding month in 1930 were valued at $3,183,500.



The Part Grinding Plays in the Building of Lycoming Airplane Engines

While Grinding is Important Wherever Accurate Metal Products are Manufactured, it is Especially Necessary in Making Airplane Engines

By CHARLES O. HERB

THE reason grinding has become indispensable wherever metal parts must be finished within close limits of accuracy is because this operation gives a high quality of finish to specified dimensions at lowest costs and with fastest production rates. Nowhere are these advantages more essential than in the manufacture of many parts used in airplane engines. Typical grinding operations in the airplane engine division of the Lycoming Mfg. Co., Williamsport, Pa., will be described in this article.

The airplane engine produced by this company is of the nine-cylinder, radial, air-cooled type. It has received from the Department of Commerce a rating of 215 horsepower at 2000 revolutions per minute. Among the different applications of this engine has been its adoption for the tri-motored Stinson ten-passenger airplanes flown by the Century Air Lines, Inc.

The cylinders of this engine follow the conventional design, consisting of aluminum-alloy heads, screwed and shrunk on carbon-steel barrels or sleeves. The barrels range in thickness from 1/16 to 1/8 inch along their entire length, except for the fins and end flanges. They must have a finished inside diameter of 4.6255 to 4.6245 inches for a length of 8 inches. Similar limits are specified for roundness and straightness.

The internal grinding of cylinder barrels is performed in the Heald machine illustrated in Fig. 1, which is equipped with hydraulic means for reciprocating the wheel-slide. The sleeves come to this machine rough- and finish-bored, without being reamed. They have been previously assembled to the heads. From 0.015 to 0.018 inch of stock on the diameter is removed in the grinding.

The automatic gage *A* stops the feed of the grinding wheel when the bore has reached the specified diameter within 0.0005 inch. The wheel is then allowed to glaze, after which it is reciprocated back and forth in the work for about ten minutes without feeding it. The result is a highly polished bore. During the grinding and "burnishing," the work speed is about 300 revolutions per minute, and the wheel-slide makes six reciprocations per minute. A 4-inch free-cutting abrasive wheel is used.

Accurate locating of the assembled cylinder head and barrel for this operation is obtained by loading it in the headstock from the left-hand end, which is shown open in Fig. 2. First, a locating ring is mounted on the cylinder barrel. When the unit is placed in the headstock, the locating ring registers with hardened and ground steel strips spaced

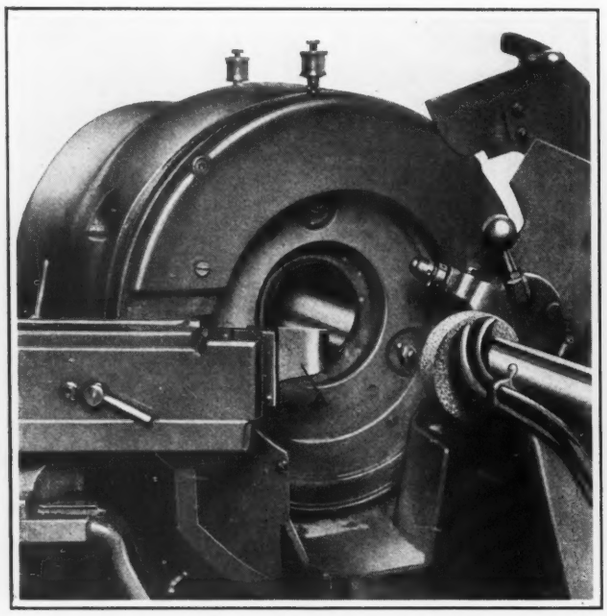


Fig. 1. An Unusually High Finish is Obtained in the Cylinder Barrels by Grinding and then "Burnishing"

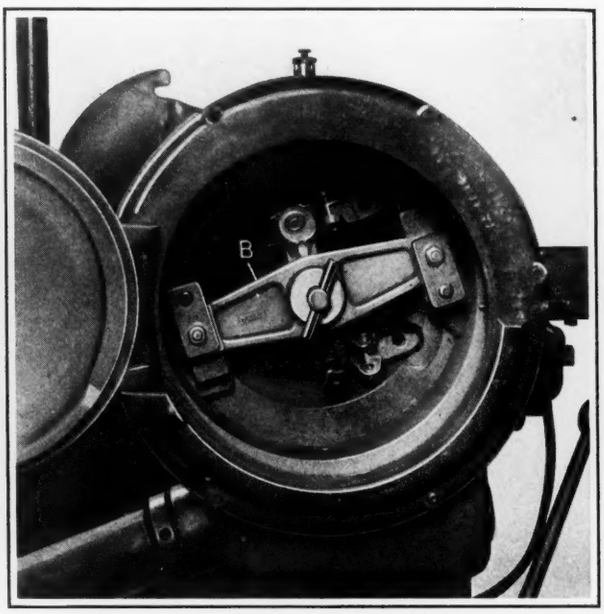


Fig. 2. View from the Loading End of the Cylinder Barrel Grinding Machine Illustrated in Fig. 1

around the bore of the headstock. This arrangement insures concentric grinding of the cylinder barrel. Clamp *B* holds the cylinder head in place longitudinally. It centers over a bracket fastened to the closed end of the cylinder head.

As in other airplane engines, the intake and exhaust cams are integral with a single steel forging. Fig. 3 shows the operation of grinding these cams, there being eight lobes all together. Previous to this operation, the cam forging is rough- and finish-turned, hardened, and tempered. For the grinding operation, use is made of a Landis machine equipped with master cams and mechanism for moving the work crosswise to and from the grinding wheel to suit the contour of the cams. The master cams are located at the left-hand end of the

Fig. 3. The Intake and Exhaust Cams are Ground by Means of Master Cams which Regulate the Movement of the Work to and from the Grinding Wheel

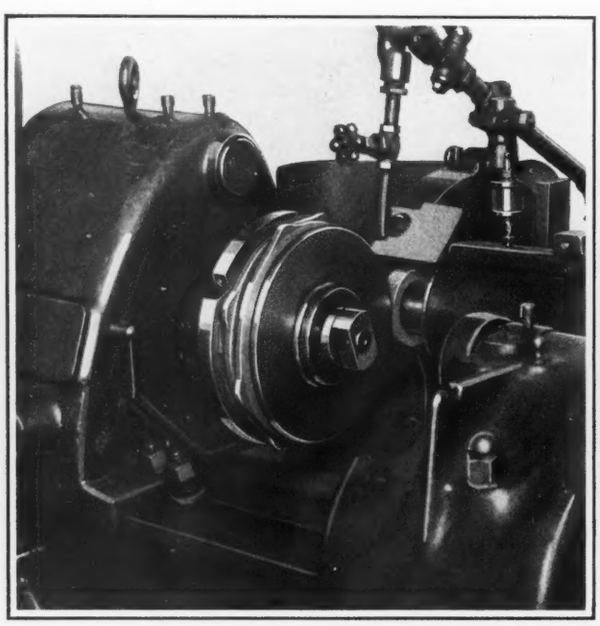
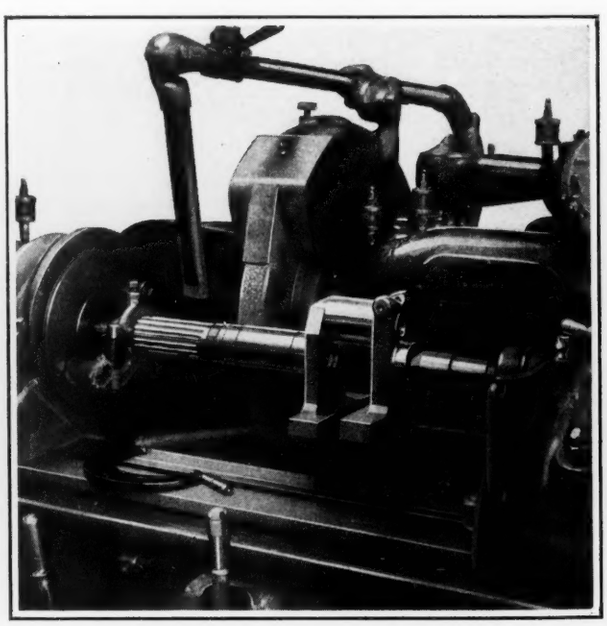


Fig. 4. Grinding Machine in which All Cylindrical Surfaces of the Crankshaft, with the Exception of the Crankpin, are Ground to Close Limits of Accuracy



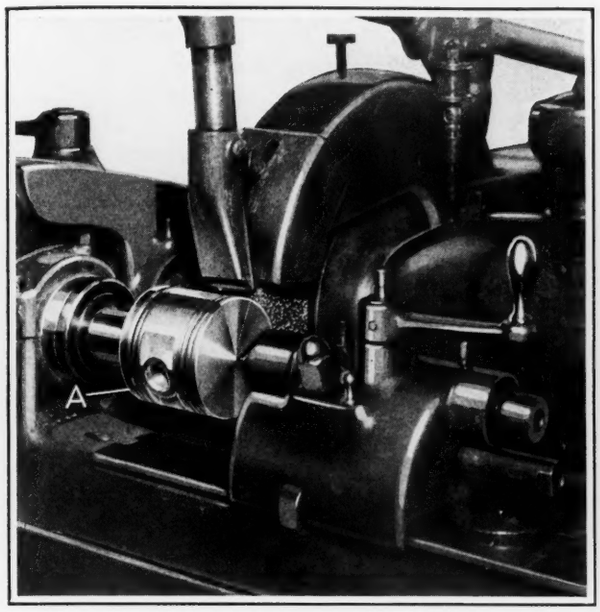


Fig. 5. In Grinding the Aluminum Alloy Pistons, the Skirt End is Seated on the Beveled Flange of Arbor A

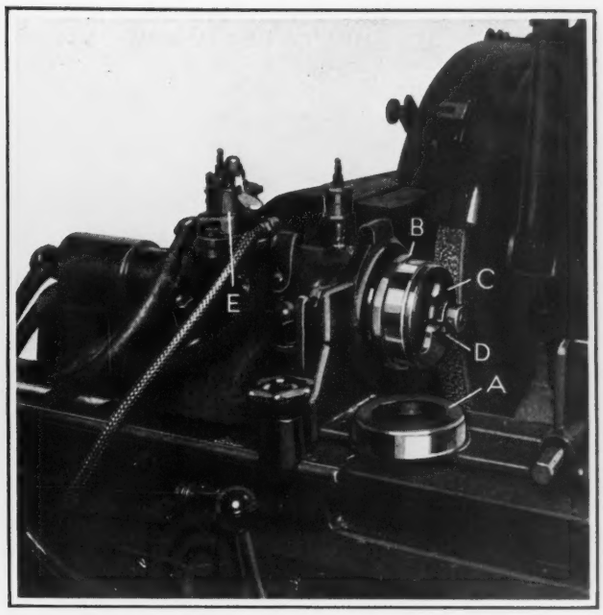


Fig. 6. An Air-operated Arbor Facilitates the Grinding of Pump Shafts, Assembled Pumps, Bearing Sleeves, etc.

work-head. The two cams are, of course, ground separately, the wheel-slide being shifted longitudinally as required.

About 0.0025 inch of stock is ground from the cam surfaces, and the dimensions are held within plus and minus 0.0015 inch. The maximum diameter across the cam lobes may vary from 10.924 to 10.927 inches. When new, the grinding wheel is 4 inches in diameter, and it is replaced when it becomes worn to 3 1/2 inches, so that there will be only negligible differences in the cam contours. The wheel is 1 inch thick.

Accurate relation of the cams to the bore of the forging is obtained by seating the forging on an arbor held in the spindle of the headstock. The proper angular location is secured by engaging a

Fig. 7. Bearing Sleeves, Pump Gears, Thrust Washers, and Similar Parts are Finished to the Required Thickness by Surface Grinding

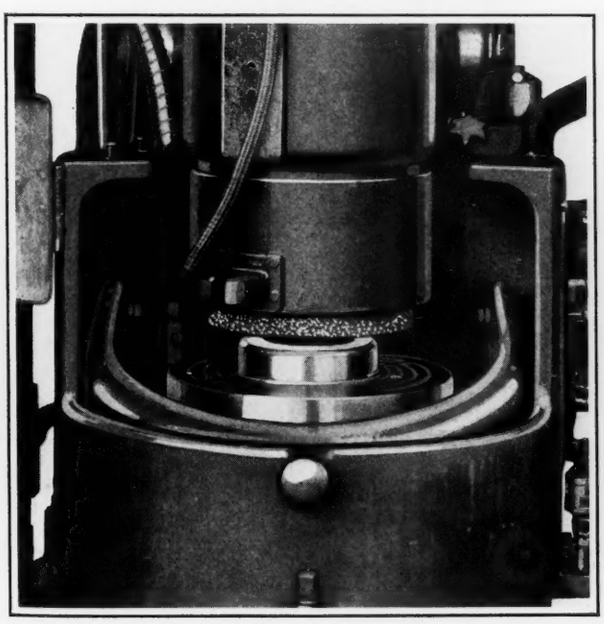
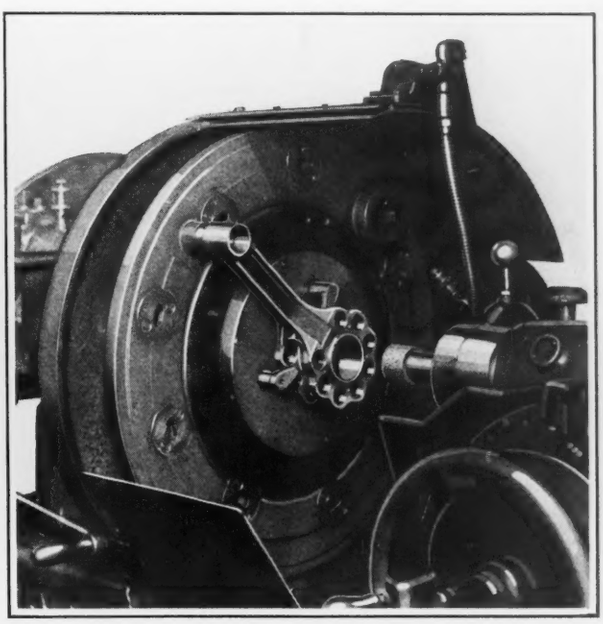


Fig. 8. All Holes in the Master Connecting-rod are Ground to Specified Center Distances by the Use of the Fixture Illustrated



block mounted on the faceplate of the machine with an internal gear tooth that has been cut central relative to one of the cam lobes. The work is held firmly on the arbor by means of a C-washer and nut. In this operation, the work revolves about two and a quarter times per minute.

All cylindrical surfaces of the crankshaft, with the exception of the crankpin, are ground in the Landis machine illustrated in Fig. 4. Some of the grinding is done before the two crankshaft parts are assembled together, but the finish-grinding of the three bearings is performed after this assembly. These bearings must be true to size and concentric within 0.003 inch. The crankpin is ground to the specified dimensions within the same limits in a Cincinnati grinder.

Another application of cylindrical grinding machines is the finishing of the aluminum alloy pistons. For this operation, the beveled internal surface in the piston skirt is seated on a beveled flange of arbor *A*, Fig. 5. A square extension on this arbor fits between the inside piston-pin bosses for driving purposes. The specified piston diameter is 4.602 inches, and the tolerance is 0.002 inch.

A cylindrical grinder equipped with an air-actuated work-holding device is employed for such work as pump shafts, assembled pumps, crankshaft bearing sleeves, and front bearing-plate sleeves. Fig. 6 shows this machine set up for grinding bearing sleeves such as seen at *A*. These sleeves are seated one at a time on arbor *B*, after which plate *C* and washer *D* are slipped on a spindle that extends through the center of the arbor. When the lever of air valve *E* is shifted, the work is gripped securely for the operation.

After the bearing sleeves are ground in the manner described, they are passed to the Pratt & Whitney surface grinder illustrated in Fig. 7, to be face-ground. Other parts, such as pump gears and thrust washers, are handled by the same equipment. This machine has an 8-inch ring-wheel and a magnetic chuck.

Fig. 8 shows another Heald internal grinding machine set up for finishing the main bearing of the master connecting-rod. The wrist-pin hole and all the link-pin holes are ground in the same machine by changing the position of the work to bring each of the holes central with the faceplate. All the holes are held to unusually close limits.

The same machine is employed for grinding the hole in the rear half of the crankshaft to suit the portion of the crankpin that it receives when assembled. This hole may be clearly seen in Fig. 4. The surface adjacent to the hole is face-ground in the same operation.

A Bryant internal chucking grinder is used for finishing small holes in many parts, such as the drive gears for the lubricant pump, the eccentric drive-shaft gear, cam idler and drive gears, and rocker arms. All holes are reamed before they reach this grinding machine. The limits on the ground dimensions, as a rule, are plus or minus 0.001 inch.

Making the Pencil Tracing a Permanent Record

By W. S. BROWN

Referring to the reproduction of pencil drawings by the photographic method, mentioned in July MACHINERY, page 832, it occurs to the writer that the term "photographic reproduction" should be amplified to make clear the great possibilities of this method. If the writer understands the idea correctly, the photographic method referred to consists of making a print on cloth which is transparent when dry, and which is prepared with a sensitized coating similar to that of the common kodak film.

The pencil drawing to be reproduced is passed through the printing machine with the sensitized cloth. The image is then developed on the sensitized cloth by spraying with a chemical solution, and is fixed by the usual method employed in photographic work. At this point, blemishes or indistinct lines can be touched up. Reproductions thus made to scale with black lines on a transparent background can hardly be distinguished from hand-made tracings, and the cost is considerably less. This method would probably be used extensively if it were more commonly known.

It would seem that the varnished pencil drawings mentioned in the previous article would be subject to cracking and that the varnish would peel off when the drawings are handled. A better method, used extensively by artists to protect crayon drawings, consists of spraying the surface with colorless spirit varnish by means of a bulb sprayer or a pressure sprayer such as is sold for small painting jobs. This varnish coating is much thinner than that obtained by the brush method, and therefore bends easily without cracking.

* * *

Machine for Rifling Four Revolver Barrels Simultaneously

By C. G. WILLIAMS

Referring to the article "Machine for Rifling Four Revolver Barrels Simultaneously," on page 929 of August MACHINERY, the question arises as to the economy of operating all four rifling tools by means of a single crank-driven slide. Usually, in an operation like rifling revolver or rifle barrels, the cutter must be reconditioned by honing after each barrel is rifled. With the present design, however, this would result in the remaining three cutters being idle during the honing period. This condition also prevails when loading and unloading the barrels.

In the past, a multiple-operation machine for this type of work has proved to be less productive than a single-operation machine, unless in the multiple-operation machine each cutter-bar is operated independently. With this arrangement, continuous operation of three of the cutter-bars is assured.

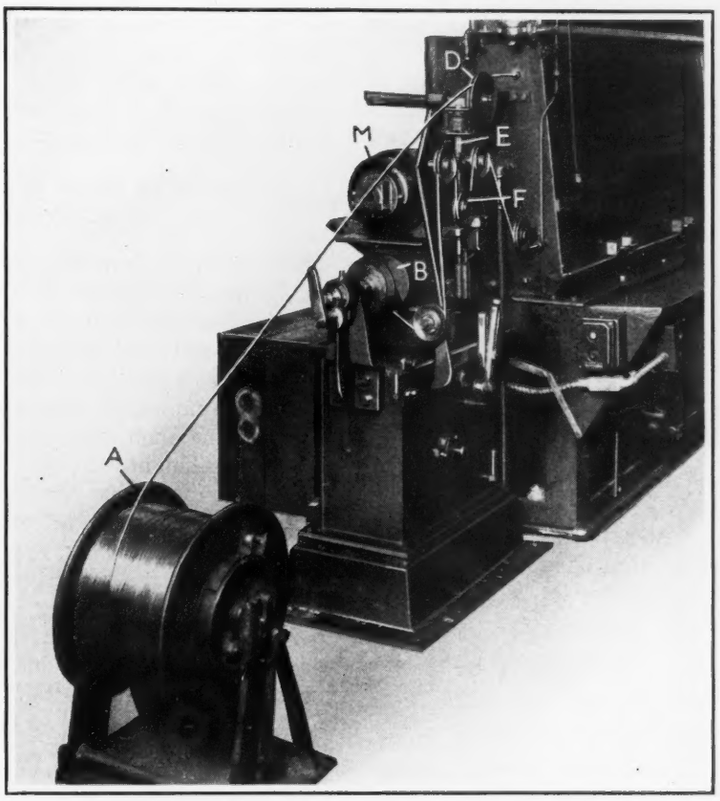
The Electron Tube in Machine Design

How the Vacuum Tube, the Photo-Electric Cell, and the Grid-Glow Tube are Being Used by Machine Designers for Grading, Measuring and Counting

By RAYMOND FRANCIS YATES

THE machine designer has found several new and important servants or tools in the vacuum tube, the photo-electric cell, and the grid-glow tube. In a way, these tubes replace the human sense organs; the vacuum tube "hears," the photo-electric cell "sees," and the grid-glow tube "feels." In each case the function is performed with amazing sensitivity and with an accuracy that is far beyond human attainment. Little wonder, then, that machine designers have come to look upon these devices as important and useful adjuncts to their profession.

Although the science of electronic control dates back but a few years, the number of successful applications already made is large and promises to be much larger. Ultimately electronic devices will cease to be mere accessories and will take their place with mechanical elements, such as levers, screws, and wheels. Considering the youth of this science, it is amazing to find the number of industries that have taken advantage of electronic control and regulation. Already they have lent valuable aid in such widely diversified operations as wire drawing, paper making, mechanical measurements, control of chemical processes, glass blowing, package machinery, cigar machinery, rolling mills, and electrical sub-stations.



Wire-drawing Machine with Rewinding Spool Controlled by Thyratron Tube

Thyratron Control for Spool of Wire-Drawing Machine

Perhaps one of the most interesting applications of the thyratron tube to a practical engineering problem has been the regulating of both the diameter of the product and the reeling apparatus of wire-drawing machinery. The automatic regulation of reeling has long been a source of annoyance to machine designers. In machinery of this kind, the wire passes from a large reel, such as shown at *A* in the illustration, to the wire-drawing equipment, where it is drawn out to the proper size and then carried to a small spool *B* on which it is re-reeled.

As the wire is drawn through the die at a constant rate, the speed at the re-reeling spool must be constantly and gradually decreased as the effective diameter of the surface on which the wire is wound increases. This involves a problem in automatic regulation that is very difficult to solve by purely mechanical devices.

In equipment of this kind, the re-reel spool is usually driven by a small direct-current motor *M*. In the development of the equipment under discussion, power was supplied to the motor armature by an electronic tube called a "thyratron." A small reactor supplied the power to the thyratron, this control being determined by the position of the core *E* in the reactor; the position of core *E*, in turn, was governed by the re-reeling operation itself, the wire running over a rider pulley *F* which is mechanically connected to the reactor core. As the loop on which the rider pulley rides decreases when the re-reeling motor is running too fast, the core is drawn into the reactor, increasing its reactance and causing the thyratron tube to pass less current. As a result, the motor slows down. Conversely, if the loop increases in length, the reactor core is withdrawn, which causes the tube to pass more current, thereby increasing the speed of the motor.

Only a small amount of work is done by the rider

pulley. The core of the reactor has a weight of but a few ounces, while the current controlled by the thyratron may be sufficient to supply a motor of several horsepower. Of course, larger tubes may be employed to control still larger motors. In the present case, the control is extended to a 3/4-horsepower motor with the field excited from a separate source of power. Provision is made so that failure of the power source causes a shut-down not only of the re-reel motor but also of the motor driving the machine itself.

Checking or Recording Wire Diameter

This is not the only benefit that has come to the wire-drawing industry through the advent of the electronic tube. There is a device in radio engineering known as the Dowling ultra-micrometer, which comprises two oscillating circuits of different frequencies. The beat frequency between them may be used—after it is amplified—to operate a recording meter. In this circuit arrangement, very small changes in capacity cause relatively large changes in the beat frequency, and since the capacity may be changed by the relative positions of two metal plates, the possibility of using this device for purely mechanical measurements is evident.

It is this principle that has been applied to the constant checking of wire diameter in the works of the Osram Co. of London, England, and it would seem only logical that this interesting apparatus should be applied to other fields of mechanical measurement in machine shops, especially in instances where the automatic checking of the product is desirable. It might be mentioned that the same principle has been successfully applied to paper-making machinery, the finished product running between condenser plates connected to such a circuit. This method has also been applied to the measurement and classification of steel sheets, differences as small as one-quarter of a thousandth of an inch being detected.

Automatic Sorting and Counting by Electronic Devices

Automatic sorting and counting is a very important function that has been successfully accomplished by electronic devices. The sorting may be done in certain instances according to the shape or by the varying shades of color. Cigars, peas and beans, etc., have been classified by the photo-electric cell with unerring accuracy.

Collapsible tubes used for shaving cream, tooth paste, and other such substances, are also sorted for holes and imperfections by whirling them over a light in front of a photo-cell. If light leakage is present, a relay is tripped and the defective article is automatically cast aside. The designers of package machinery have been greatly aided by the same device, which detects imperfectly wrapped packages, removes them from the conveyor belt, and at the same time, counts the number removed.

A new type of stroboscope recently developed promises to be of great value to machine designers who wish to study the functioning of parts moving at high speed. The apparatus involves beams of light that are flashed on and off in perfect synchronism with the movement of the parts to be studied. Under the beams of light, the moving parts of the machine appear to be stationary, and this illusion is carried to such a point of perfection that photographs may be taken. The rapid flashing of the light is accomplished by the quick charging and discharging of grid-glow tubes operating in conjunction with mechanically operated electrical contacts used on the moving parts of the machine to be studied.

The use of this apparatus has already provided interesting and valuable data in connection with the performance of airplane propellers operating at high speed, and it has also afforded a means of studying the valve action of airplane motors, enabling the observer to pick out the weak cylinders during warming-up periods. Commutator and armature connections of electrical machinery may also be studied and inspected while such machinery is operating at normal speeds. No doubt the use of this new device will grow.

Controlling Motor of Rolling Mill with Photo-Electric Tube

So ponderous a machine as a Mesta rolling mill has been controlled by photo-electric means. Here current equivalent to several hundred horsepower is nicely controlled by a current amounting to but a few micro-amperes. The object has been to reduce the amount of manual labor needed in connection with such machines for reversing the motion of the hot billets.

The moving billet simply intercepts a beam of light, which, in turn, affects the resistance of the photo-electric cell. This, operating through a series of amplifiers, relays, circuit-breakers, and other special circuit-controlling equipment, controls the operation of the machine. The point to be observed here is that the magnitude of an operation does not necessarily prevent its being brought under electronic control.

Other Interesting Applications of Electron Tubes

The designers of elevator equipment have recently found a use for photo-tubes in bringing cars to the correct level automatically. So successfully has this method worked that during the last three years all the newly installed button-controlled cars have been provided with this system.

A steam valve manufacturer has recently provided a large valve which may be operated by the human voice amplified through a series of vacuum tubes. This valve may be either opened or closed in this manner, although the voice of the operator may be transmitted many miles. This application is not so practical as it is interesting. It shows, however, that the movement of heavy masses by electrical motors may be very easily brought under perfect control.

Boston Exposition Shows Progress in Metallurgy

Five Engineering Societies Hold Meetings in Conjunction with the Metal Show Held this Year in New England

THE annual Metal Exposition, held in Boston, September 21 to 25, in conjunction with the Metal Congress, was a most successful event. The Congress was participated in by the American Society for Steel Treating, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, the Society of Automotive Engineers, and the American Welding Society. The area covered by the exhibits on the Commonwealth Pier, where the show was held, was 50 per cent greater than the exhibition space at the Chicago show last year. There were over 150 exhibitors, occupying 60,000 square feet.

The displays included almost every kind of steel, as well as non-ferrous metals and alloys, including aluminum, copper, zinc, brass and bronze. In addition, many other raw materials, tools and manufacturing equipment were on exhibit. Gas and electric furnaces in practically all sizes were shown in operation. Welding equipment occupied a prominent place, and the fact that practically all the equipment that could conveniently be shown in operation was so exhibited added a great deal both to the interest and the value of the exposition.

During the sessions of the Metal Congress, some seventy-five papers were read, covering almost every phase of metallurgy and many branches of the machine-building and metal-working industries. The sessions of the American Society for Steel Treating continued throughout the week, as did also those of the American Welding Society and the American Institute of Mining Engineers. The mechanical and the automotive engineers each devoted one day to their sessions—the mechanical engineers Tuesday, September 22, and the automotive engineers Wednesday, September 23.

Mechanical Engineers' Program Included Three Technical Papers and Two Fine Movies

Three technical papers were read at the session held by the American Society of Mechanical Engineers. One of these discussed power transmission with cast-iron pulleys and with paper pulleys. This paper was the result of experimental and test work carried on by the authors, Professors C. A. Norman and G. N. Moffatt, at the laboratories of the Ohio State University. This paper gave details on transmission efficiency of various types of belts on cast-iron and paper pulleys.

A paper entitled "Positive Drive Equipment" was read by C. R. Weiss, chief engineer of the Link-Belt Co., Indianapolis, Ind. This paper dealt with various forms of chain drives and with geared speed reducers. Having been connected with the Link-Belt Co. for over twenty years, Mr. Weiss has become an authority on chain power transmission.

The third paper read at the mechanical engineers' session covered recent advances in the use of X-ray equipment for the inspection of steel castings and welded structures. The author, H. R. Isenburger of the St. John X-Ray Service Corporation, New York, covered the applications possible with this new means of inspection. The objectionable conditions in steel castings and in welded joints that are revealed by radiographic examination were listed, and the advantages of the method were pointed out.

The session closed with the showing of two films, one from the Westinghouse Electric & Mfg. Co. relating to the company's research work, and the second from the Leipzig Trade Fair, giving a comprehensive idea of German machine tool progress as exhibited at the Fair last spring. An opportunity to visit the Watertown Arsenal was also included in the program.

Automotive Engineers Feature Heat-Treating Methods and Costs

The program of the Society of Automotive Engineers comprised three timely papers on important subjects, two of which dealt with the methods and costs of heat-treating, making available useful information bearing especially on the economical side of the subject. The third paper dealt with the characteristics of alloy cast iron, a subject that has become especially important within the last two or three years.

Welding Society Covers Almost Every Branch of the Welding Art

The sessions of the American Welding Society covered a broad range of subjects. An idea of the comprehensiveness of the program may be obtained from a brief review of the main subjects that were dealt with, which included the Yale University group of welded buildings; welded ship construction; flash-welding of mild steel; automatic gas-cutting; welding of galvanized steel; fatigue properties of welds; relief of welding stresses by annealing; use of welded piping and fittings in heating installations; welding of copper and brass piping; factors affecting the weldability of steel; semi-automatic gas welding; and under-water cutting.

The meetings and the exposition were well attended, in spite of the difficulties that the present business conditions obviously place in the way of a record attendance.

EDITORIAL COMMENT

Many manufacturers have asked themselves the question, "Is there anything that I can do individually to minimize the effects of the business depression?" The question has been answered in the affirmative by a great number. They have devised means for employing as large a number of men as possible, at least part time; they have developed new designs to stimulate the market; they have shown confidence in the increased demand that they definitely expect by building for stock; and many have, besides, done their share in creating a demand by re-equipping their shops and putting them in order for the next busy period.

The last method is one that is likely to pay good dividends in the future. It is a method by which every forward looking concern, able to command a reasonable amount of capital at the present time, can further not only its own interest but also that of the industry as a whole. If only one-half of the manufacturers throughout the country would make a thorough study of their present plant, decide upon what is obsolete and useless, and replace it by efficient machinery, business would show a decided improvement at once.

Helping to Bring the Business Ship into Port

At a time when there have been serious discussions of wage reductions, constructive work of this kind would also furnish an answer to the wage question. There are few plants that are so efficient that a thorough study of manufacturing and distributing methods would not indicate possibilities of saving a much larger percentage than could possibly be gained by a wage reduction. Labor, as well as capital, will benefit by up-to-date shops that are able to produce efficiently and profitably, for only such shops can pay good wages and reasonable dividends.

Research work can be done more effectively by large industrial concerns than by the smaller manufacturer. The latter, no matter how enterprising, lacks the necessary resources. It requires physical and chemical laboratories of considerable size to do effective industrial research and experimental work, and only businesses conducted on a large scale are able to carry on this costly work and to maintain the research staffs necessary to do it effectively.

Credit should be given to the larger industrial companies for what they have done in this direction. Some of them appropriate very large sums for developing industrial processes and new mechanical and electrical equipment. Much of the progress in engineering is due to the pioneer work that has been done by the big industries.

Most Research Work Has Been Done by Large Plants

It is true that these laboratory investigations are intended to benefit, in the first place, the particular corporation that spends its money in carrying on the research work. Nevertheless, these discoveries ultimately prove of value to the industries generally, and through the industries, to the public at large.

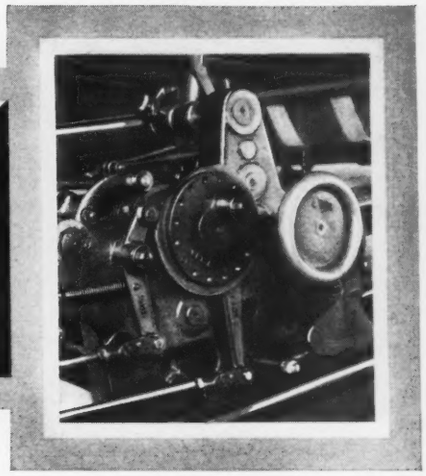
The fact is not overlooked that many manufacturers with moderate-sized plants, inventors, and those who seem to be born investigators have done much to further industrial development; but some of the most important discoveries in industry and applied science may be traced directly to the laboratories of the larger firms. This is especially true in these days of radical new applications of electricity. If it had not been for the large organizations that could afford to spend freely on research work, some of the things that are now considered commonplace, but that would have startled the world twenty years ago, might have remained unknown.

In ordering machinery and tools, many buyers demand an accuracy that is unnecessary. The machine builder and tool manufacturer, having no means of determining whether or not the accuracy is essential, will make the equipment in accordance with the specifications. This frequently results in increasing the cost to the buyer considerably. There are cases on record where specifications have called for an accuracy that would have cost several thousand dollars to obtain. Upon investigation, it has been found that the extreme accuracy called for was wholly unnecessary, and a satisfactory tool has been made for $40 or $50.

Too High a Price Is Sometimes Paid for Accuracy

A careful check should be made of the limits of accuracy asked for on all tools that are bought for manufacturing operations, especially those that have to be made to order. It is possible that a great deal of expense might be saved by eliminating unnecessarily close tolerances. There is always a tendency to make the tolerances close, so as to be on the safe side, but it is often a very expensive practice. Here is a field in which much waste can be eliminated.

Ingenious Mechanical Movements



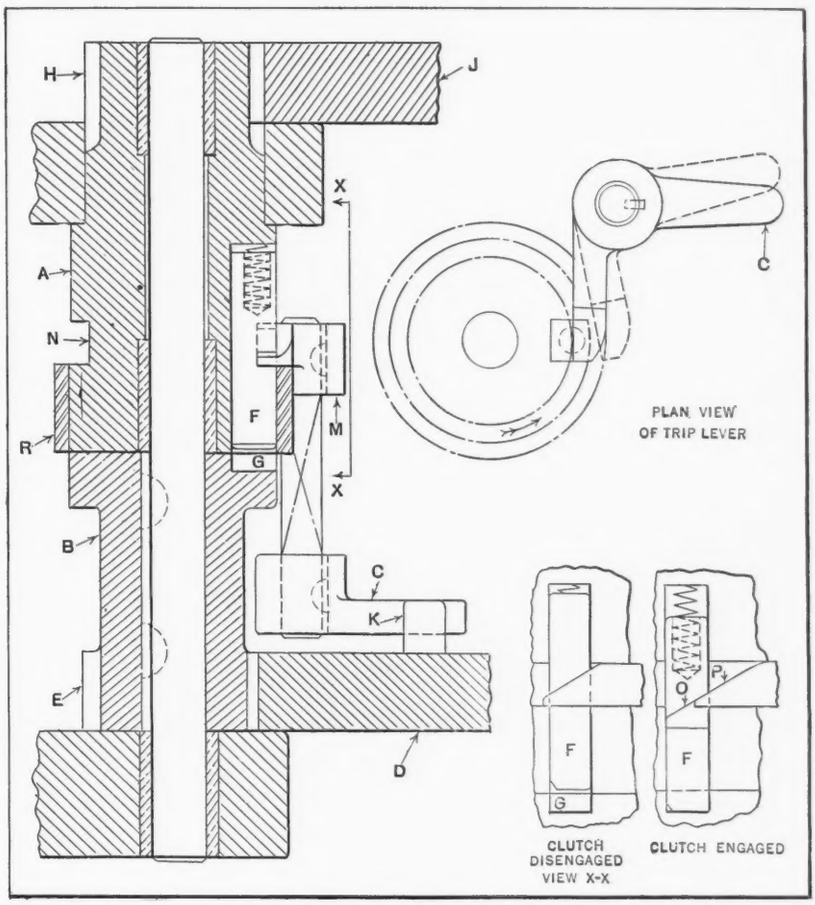
Intermittent Movement for Indexing Plate

By EDWARD HELLER

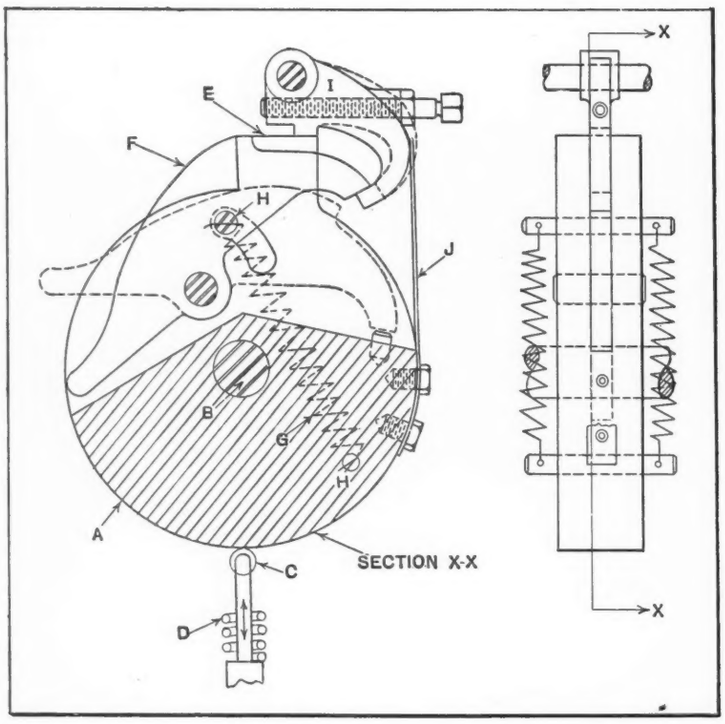
The accompanying illustration shows a mechanism for transforming continuous rotary motion into intermittent rotary motion. A movement such as this is often applied to indexing plates or tables of multi-stage drilling or chucking machines. The mechanism consists chiefly of two clutch members *A* and *B*, which are automatically disengaged at uniform intervals by means of a key actuated by the trip-lever *C*.

The driving gear *D* is rotated uniformly, receiving its motion from some other member of the machine. This gear meshes with the pinion *E* on the lower clutch member *B*. In the upper clutch member *A* is a sliding key *F*, which is backed up by a coil spring. This key is forced by the spring into the slot *G* when the lower clutch member is rotated into a position where the key and slot are in alignment. When this engagement occurs, both members of the clutch are locked together. The ring *R*, which is shrunk on the lower part of the clutch member *A*, serves to retain the key in its slot.

Pinion *H* is integral with the upper part of the clutch member *A* and meshes with the gear *J*. This gear, in turn, serves to drive an indexing plate (not shown). The clutch is engaged through the action of the pin *K* in the driving gear *D*; and at a certain point in the rotation of this gear, the pin trips the lever *C* so that the lever and the dog *M* assume the position indicated by the dotted lines in the plan view. The shaft on which the lever and dog are keyed rotates in a stationary bearing secured to the machine. As soon as the point of the dog is lifted out of the wedge-shaped slot in the key, the latter is free to drop down into the slot *G*, provided the two members of the clutch are located in the proper position radially. When



This Clutch is Operated Intermittently through the Action of a Trip-lever



Quick-tripping Mechanism for Clamping Device

the key enters the slot *G*, the gear *J* rotates. In the meantime, the pin *K* has passed the lever *C*, and the dog *M* is returned to its original position in the annular groove *N* by a spring (not shown).

When the clutch has rotated nearly a complete revolution, the bevel face *O* on the key *F* comes into contact with the bevel *P* on the dog; and as the clutch continues to rotate, the key is forced upward and out of the slot *G*, as shown in the views at the lower right-hand side of the illustration.

This mechanism will operate satisfactorily at speeds up to 50 revolutions per minute, but at higher speeds, the key is not given sufficient time to drop into the slot *G*. If accurate indexing is required, the usual plunger arrangement for the indexing plate is used in conjunction with the mechanism described. A mechanism of this type lends itself very well to jobs where it is necessary to vary the indexing ratios. To obtain the various ratios, the gear *H* may be made demountable with respect to clutch member *A*. In this way, gears *H* and *J* can be changed to suit the required indexing ratio.

* * *

Quick-Tripping Mechanism

By RAYMOND O. KRENGEL

In designing a special clamping device, it was necessary to incorporate a quick-tripping mechanism which would provide for a rather slow releasing and an almost instantaneous clamping action. The mechanism designed for this purpose consists of a common plate cam *A*, as shown in the accompanying illustration, and an involute cam *F* pivoted in a slot cut through the middle of the plate cam. These two cams actuate the cam-roll *C* which performs the required tripping and releasing operations.

The shaft *B*, to which the plate cam *A* is keyed, has a reversing motion. It revolves approximately 180 degrees in a counter-clockwise direction, reverses, and then returns to the starting position, keeping this oscillating movement continuous. As the plate cam *A* revolves in a counter-clockwise direction, the roll *C* is gradually depressed by the cam *F*, causing the clamping device to be released slowly. When the cam *F* reaches the point where the roll *C* is in contact with the lobe *E* of the cam *A*, the clamp is fully released, and continued rotation of the cam brings the end of the adjusting screw of latch *I* into contact with roll *C*, causing the latch to release cam *F* and allowing the springs *G* to draw the cam into the position shown by the dotted lines.

At this point the direction of rotation of shaft *B* is reversed by a mechanism on the machine, which is not shown in the illustration. As the cam assembly turns in a clockwise direction, the roll *C* reaches the end of the dwell surface of lobe *E* and is returned into contact with the concentric portion of cam *A* with a very sudden action through the tension exerted by spring *D*. This sudden movement of roll *C* engages the clamping device almost instantly.

As the cam continues to rotate, the roll *C* comes into contact with the protruding end of cam *F*. As the tension of spring *D* is sufficient to overcome the tension of springs *G*, the cam *F* is returned to the position shown by the full lines, where it is held by latch *I*, which is under the tension of the flat spring *J*. The mechanism is thus set in position for a repetition of the cycle just described, upon the reversal of the shaft *B*.

* * *

Ratchet Feed with Safety Attachment

By R. H. KASPER

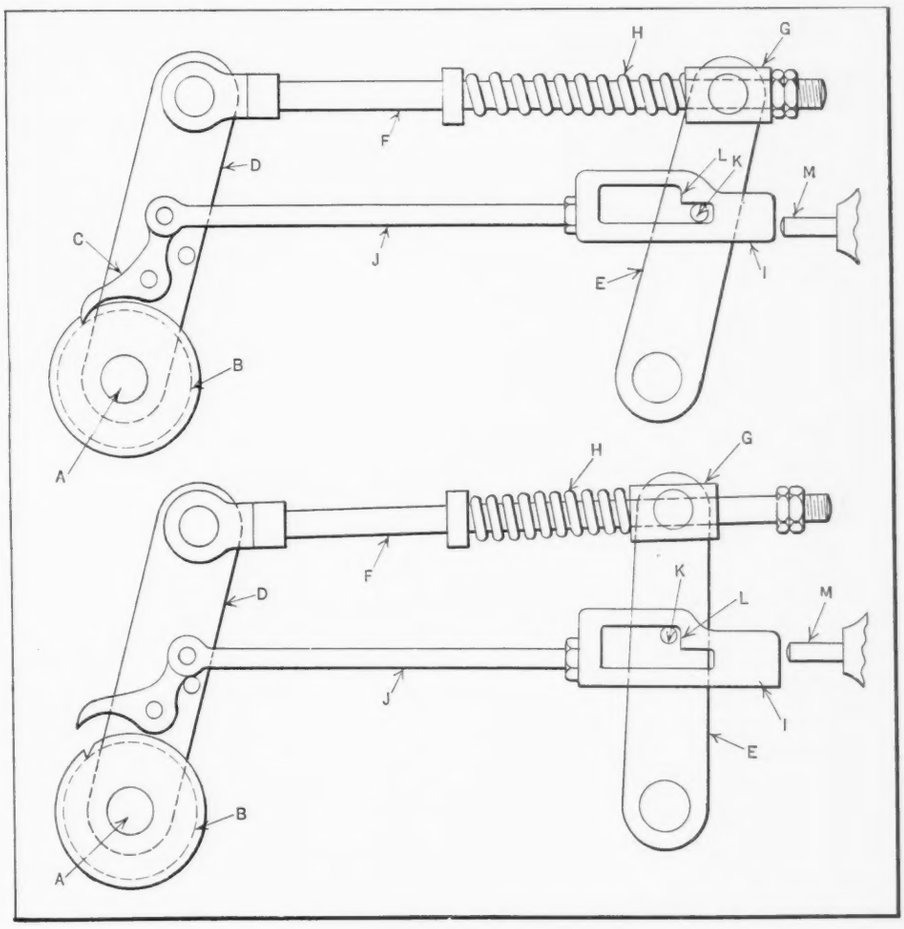
In the accompanying illustration is shown a ratchet feed mechanism provided with a safety attachment that protects the mechanism from breakage in case the feed becomes jammed, and that also serves to stop the machine when this occurs. The attachment is so designed that the feed can be reengaged as soon as the obstruction has been removed. Previous to the installation of this attachment, a shear pin was used to protect the feeding mechanism from breakage. The shear pin arrangement merely protected the feed mechanism and did not prevent the loss in production that resulted from operating the machine while the feed was jammed; in addition, it required the suspension of production while the shear pin was being replaced.

Referring to the illustration, the feed-shaft *A* is given an intermittent rotary movement by means of the ratchet wheel *B* and the pawl *C* which is carried on lever *D*. Lever *D* receives its movement from lever *E* through the connecting-rod *F*. Lever *E* carries the swinging yoke *G* through which rod *F* passes. Rod *F* carries the spring *H*, which is compressed when the load on shaft *A* exceeds a predetermined limit. Pawl *C* is connected to the plate *I* by the connecting-rod *J*. Plate *I*, which has an irregular-shaped hole, rests on pin *K* carried on lever *E*. Under normal conditions, connecting-rod *J* carries no load, merely riding between levers *D* and *E*.

The operation of the safety attachment will be understood from the following. The upper view of the illustration shows the mechanism in its normal operating position. The oscillating movement of lever *E* is transmitted to shaft *A* by pawl *C*, which is held in engagement with the ratchet wheel *B* by a spring (not shown).

Should the movement of shaft *A* be prevented, the continued movement of lever *E* would simply result in compressing spring *H*, thus preventing the breaking of parts. The forward movement of lever *E* carries pin *K* into the larger portion of the irregular hole, as indicated in the lower view. On the return stroke of lever *E*, the pin *K* engages the shoulder at *L* on plate *I*, thus causing pawl *C* to remain out of engagement with ratchet wheel *B*, and preventing further movement of shaft *A*, although the machine may not be stopped immediately. In this position, plate *I* extends beyond lever *E* sufficiently to push over the rod *M* far enough to open the electric switch that controls the driving motor, and thus cause the machine to come to a stop.

When plate *I* is lifted and disengaged from pin *K*, the machine is again ready to start, but if the resistance of shaft *A* is greater than the tension of spring *H*, the machine will again be stopped on the first stroke of lever *E*. In the actual construction, two pairs of levers *D* and *E* are used, the mechanism being located between them. In order to show the mechanism more clearly, however, the outer levers have been omitted in the illustration.



Ratchet Feed with Attachment for Protecting Mechanism and Stopping Machine if Feed Jams

Cutting Worm-Gears with Spur-Gear Cutters

Commenting on the article "Cutting Worm-Gears with Standard Spur-Gear Cutters," published in August, 1931, MACHINERY, page 927, O. G. Simmons, president and general manager of the National Tool Co., Cleveland, Ohio, informs us that he was the first user of gear-shaper cutters having teeth cut longitudinally relative to the axis to generate the threads in a worm by disposing the cutting edge of the cutter normal to the thread helix. He obtained on this method patent No. 1,426,680, dated August 22, 1922, the application for which was filed April 10, 1918. The National Tool Co. is now operating under this patent.

* * *

Home-Study Course in Drawing

The University of Wisconsin, Madison, Wis., is conducting a home-study course in advanced shop drawing which offers training through the correspondence-study method to men aspiring to gain wider experience in the technical field. The course is intended for men who wish to become draftsmen or who want to acquire a working knowledge of mechanical drawing for shop use.

High-Speed Die for Multi-Slide Machine

Design and Operation of a Set of Tools that Pierced, Blanked, and Formed 3,000,000 Pieces at the Rate of 125 per Minute—Second of Three Articles

By F. C. DUSTON

SOME of the principal features of a multi-slide machine developed by the U. S. Tool Company, Inc., Ampere, N. J., were described in September MACHINERY, page 25, in connection with the description of a die and forming tools used for producing a small part at the rate of 300 per minute. Although the die described in the present article is not operated at such a high speed, it can nevertheless be classed as a high-speed die, as it produces 125 finished pieces per minute like the ones shown at *E*, Fig. 1.

The multi-slide tool equipment shown in Fig. 1 has already produced 3,000,000 of these small pieces from "1/4 hard" coiled brass stock, 5/16 inch wide by 0.020 inch thick. The life of this die is rather remarkable, considering the speed at which it operates, the nature of the blanking, piercing, and forming operations performed, and the accuracy demanded.

Three operations, as indicated on the piece of stock *C*, Fig. 3, are required in the production of this piece. The length of feed in this case is 2 5/32 inches, although the trimming die extends toward the in-feed end of the die for a distance *V*. Thus, the length of the work trimmed by this portion of the die is overlapped by the trimming dies for a length *U* in the first-operation position. This and other interesting features of the die will be noted in referring to the cross-section of the assembled die at the top of Fig. 3 and the plan and cross-sectional views of the die and punch members shown in the lower views.

The light extension lines that pass through the work and the views of the punch and die are shown to assist in identifying the operations performed on the work with the parts of the die and punch members that perform them. For clearness, the various parts are indicated by the same reference letters in Figs. 1, 3, and 4.

The tool equipment described in this article requires a somewhat different set-up on the multi-slide machine than the equipment described in

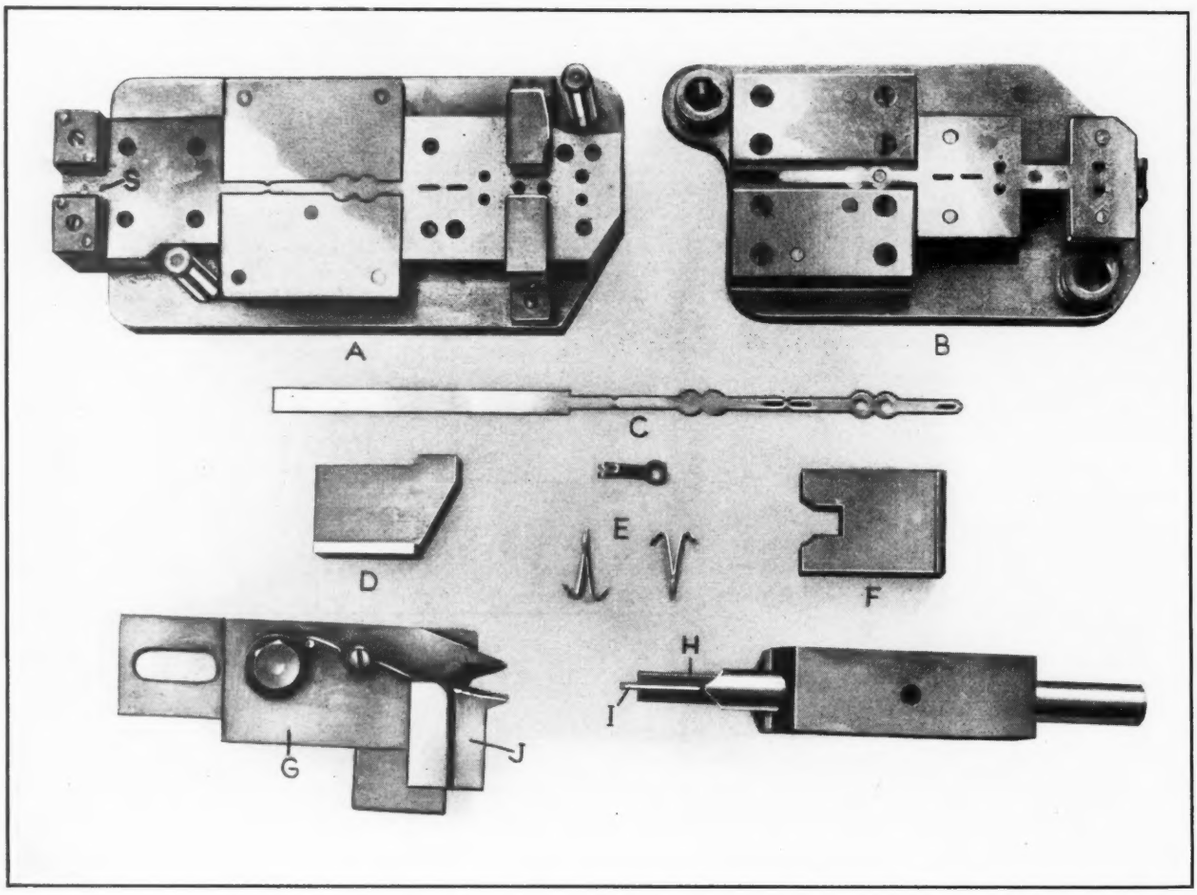


Fig. 1. Die and Forming Tool Equipment Used on Multi-slide Machine for Producing Parts E

September MACHINERY. In the case of the tool equipment described in the present article, a vertical slide operated by a bell-crank lever, such as shown at *A*, Fig. 2, is required to impart a vertical movement to the member *I* of the forming punch shown in Figs. 1, 3, and 4. Incidentally, the particular machine shown in Fig. 2 is set up for producing the part shown at *M*, Fig. 1, in the September article. Some of the finished parts are shown at *B*, Fig. 2. These parts are made from "1/2 hard" brass stock, shown on the table at *C*. This stock is 1/2 inch wide and 0.020 inch thick. The feed required for this part is 2 1/16 inches, and the production is 125 pieces per minute.

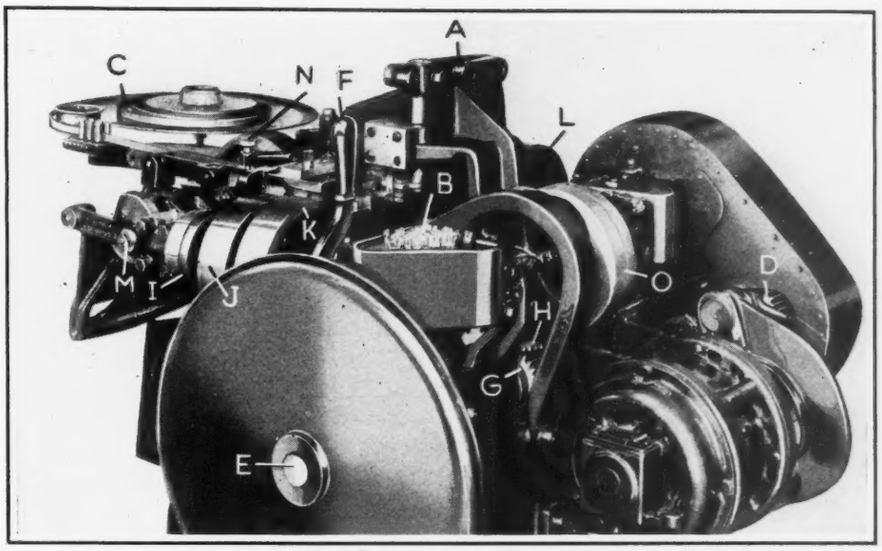


Fig. 2. Type of Multi-slide Machine on which Tool Equipment Illustrated in Fig. 1 is Used

Although the machine shown in Fig. 2 is equipped with tools for producing a different piece, the same general arrangement is employed for making the part shown at *E*, Fig. 1. Briefly, the method of transmitting power and motion to the tools is as follows:

Spur pick-off gears, one of which is shown at *D*, Fig. 2, drive the main shaft *E* through a clutch operated by lever *F*. The pick-off gears are so arranged that they can be easily and quickly changed when a different operating speed is required. The spur gear *G* on shaft *E* drives gear *H*, which is keyed to the camshaft on the right-hand side of the machine. Miter gears at each end of this shaft, which are enclosed in housings, transmit power to the front camshaft, on which the cams *I*, *J*, and *K* are mounted, and also to the back camshaft, on which the cams *L* are mounted. This shaft, in turn, transmits power to the camshaft at the left-hand side of the machine through miter gears. At the front end of the latter camshaft is the adjustable crank-pin *M*, which actuates the stock-feeding mechanism. At *N* is the small lever which controls the clamping jaws of the feeding mechanism.

The cam shown at *I* actuates a clamp which presses the stock against the die surface *S*, Figs. 1 and 3, during the return stroke of the feeding clamp. The cam shown at *J*, Fig. 2, operates the slide to which the punch member *B*, Figs. 1 and 3, is secured. The cam at *K*, Fig. 2, operates the forming tool, consisting of the members *G* and *J*, Figs. 1 and 3, while the cams at *L*, Fig. 2, actuate the bell-crank *A* and the slide *F*, Fig. 3. The cam *O*, Fig. 2, operates the slide to which member *D*, Figs. 1 and 4, is secured. This part, in turn, actuates the sliding member *J*, as required in forming the piece.

Referring to Fig. 3, let us assume that a piece of stock has entered the die, in the direction indicated by the arrow at *T*, up to the point *W*, and that it is clamped in this position while the punch member *B* is advanced and withdrawn. On the next feeding stroke, the end of the stock at *W*, from which the sides have been trimmed as indicated by the shaded portions, will have advanced to position *X*. On the next inward stroke of the member *B*, the shaded portion shown in the first-operation section will be trimmed from the sides of the stock, together with the shaded portion in section *V* of the succeeding piece. The shaded elongated hole at the end *X* will also be pierced in this operation.

A particularly interesting feature of this equipment is the manner in which the trimming die disposes of the scrap stock. As the guide plates on the member *B*, shown in the lower view, are somewhat thicker than the stock, they depress the stripper plates on member *A* before the trimming edges of the die come into action. Thus, on the return stroke of member *B*, the stock will have been returned to its normal position by the stripper on part *B* before the strippers at each side of the punch member *A* have forced the trimmed pieces out flush with the surface of the punch.

Then, when the stripper on member *A* has returned to its normal position and member *A* has withdrawn, there will be sufficient clearance between the work and the scrap material to permit the scrap to fall from the die or be blown downward by a blast of air. It is understood, of course, that the die operates in such a position that the stock is fed through in a vertical or edgewise position. Thus, the lower stripper on member *A* will ordinarily be depressed sufficiently when the trimming action occurs to permit the scrap from the lower side of the stock to fall directly downward, so that it clears the die. The preceding description, therefore, applies more particularly to the scrap affected by the upper stripper.

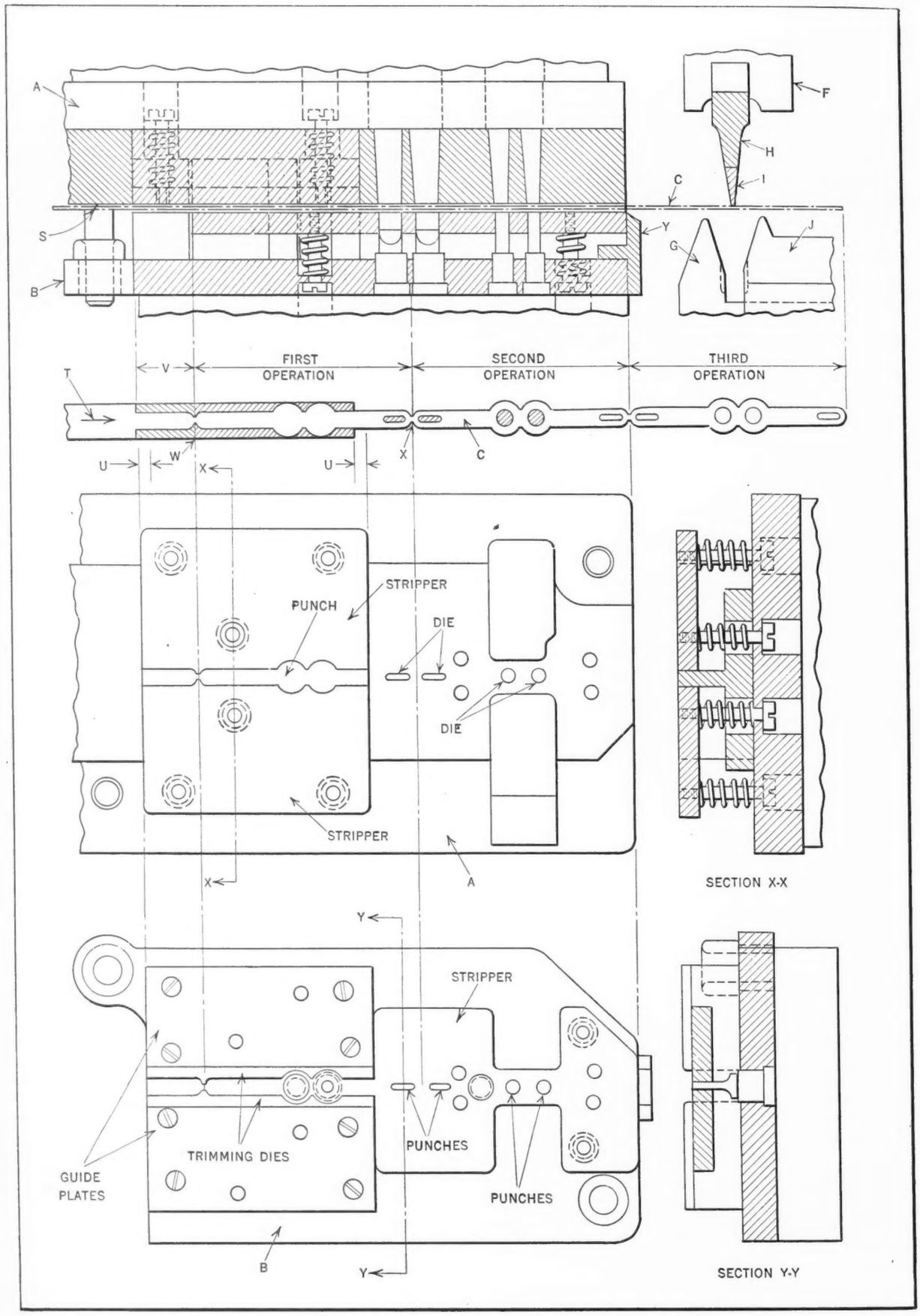


Fig. 3. Section and Plan Views of Die and Forming Tools Shown in Fig. 1

In the second position, the shaded elongated hole at the opposite end of the piece is pierced, as well as the two round shaded holes.

On advancing to the third position, the forming tools *G* and *J* advance while the piece is being cut off by the shear *Y*. The piece is first bent or formed over the member *I*, as indicated in the view to the extreme left, Fig. 4. When this position has been reached, the member *I* is raised vertically so that it clears tools *G* and *J*. The member *D* then advances, causing part *J* to close the U-formed bend at the lower end of the work.

The shape of the work and the relative positions of the forming tools at this stage of the operation are shown in the central view, Fig. 4. The final forming operation on the part is completed when the member *F* advances to the position shown in the view at the extreme right, Fig. 4. After forming the piece, the tools return to their original positions. A complete piece is produced each time the stock is advanced.

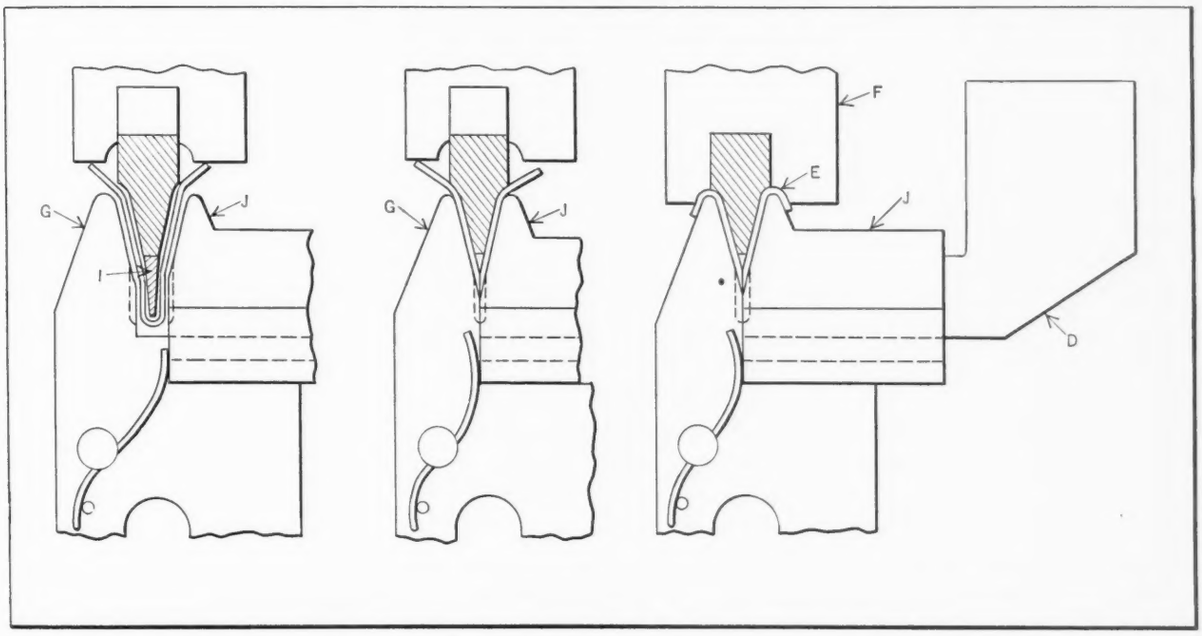


Fig. 4. First, Second, and Final Stages of Forming Operations on Part E

* * *

A Word of Cheer

Arthur J. Tuscany, manager of the Gray Iron Institute, Inc., Cleveland, Ohio, reports: "For the first time in three months an increase is shown in the amount of new business recorded. There has been an increase in the volume of new business of about 12 per cent during the month of July (the last month for which complete statistics are available). This is a rather unseasonable increase and undoubtedly shows that industrial concerns are being compelled to replenish their stock of castings to care for the normal increase in business during the early fall months."

Drilling a Hole Through a Rubber Roll

By C. G. WILLIAMS

The brass tube used in drilling a rubber roll, as described in August MACHINERY, page 943, need not have had the inside of the cutting end tapered. The end of the tube could have been left as cut off, with the exception of being made as smooth as possible and having the corners slightly rounded. Then, had a water pressure of about 50 pounds been maintained in the tube, the rubber roll could have been pierced without withdrawing the tube from the work and without using kerosene as a lubricant. It would not have been necessary to reverse the work, and the core could have been forced out of the tube by water pressure.

Kerosene is undesirable as a lubricant, because it dissolves the rubber and forms a sticky residue over the inside of the roll and over anything that comes in contact with it. Its effect will be noted in the hole in the rubber after several days have passed and the kerosene has apparently evaporated. Water seems to be the only satisfactory lubricant for rubber.

* * *

According to a paper read before a meeting of the Society of Automotive Engineers by Thomas H. Wickenden, of the International Nickel Co., Inc., a good cutting oil for machining nickel alloy steel is a mixture of 8 to 10 per cent lard oil, 0.8 to 1 per cent flour of sulphur, 10 to 20 per cent kerosene, and the balance mineral oil to give a viscosity of about 200. This mixture gives a fine finish on soft steels. The presence of kerosene prevents any "pick-up" of fine particles on the tool point.

Stabilization of Business and Employment

In a Study of the Conditions that Characterize the Business Cycle, Ralph E. Flanders Reaches Conclusions of Interest to Every Industrial Executive

AT the meeting of the Industrial Institute, 347 Madison Ave., New York City, held at Silver Bay, Lake George, N. Y., August 10 to 25, Ralph E. Flanders, manager of the Jones & Lamson Machine Co., Springfield, Vt., presented a paper entitled "What Industrial Management Has Learned in the Last Two Years." In this paper Mr. Flanders reviews the results of a study into the conditions by means of which greater business stability may be obtained, together with a more even distribution of industrial employment. After reviewing production and sales policies, he deals at length with the question of personnel and wages. He endorses the policies for stabilizing employment announced by the General Electric Co. about a year ago (published in October, 1930, MACHINERY, page 108), and then proceeds to deal with the subject of shorter hours as follows:

"It mitigates the burden of unemployment if the practice is followed of reducing hours rather than letting good men go. Hours cannot, however, be reduced beyond the point where good men will leave to get other jobs. As the period of bad business continues, good men will endure shorter and shorter hours without leaving. This point must be carefully watched, as the training of new men is expensive. The length of the working hours can be revised from time to time as unemployment increases.

Would a Shorter Working Week Tend to Stabilize Employment?

"There are many reasons for believing that the whole manufacturing industry of the country is ready at this moment for a forty-hour week with cumulative over-time. A good case can be made out for this proposal from the standpoint of industry. The following are some of the possible benefits:

"While we have no definite, reliable measure of the improvements made in machinery, methods, and management, we can be sure that these have made very great advances since the war, and that further advances of perhaps equal magnitude are in prospect. The normal result of these improvements is, of course, the production of more goods with shorter working hours.

"These shorter working hours, however, do not have a socially useful form. For instance, there is a tendency for the displaced workers to make places for themselves in all sorts of 'white collar' jobs; hence, the multiplication of selling and service activities of all sorts, which have had a mushroom growth with an elaboration and increased expense in almost exact ratio to the improvements in production. These sales and service activities are of a precarious sort, and in their present forms they cannot be permanent, because they are essentially inefficient.

"It would seem that the common-sense way to take care of our increased effectiveness in production would be to recognize it by purposely shortening working hours. It may be difficult to predict in just what way this would have a stabilizing effect on business, but we can conceive of no permanent solution of the problem of sustained prosperity which does not translate improved knowledge and efficiency into shorter working hours; and it seems reasonable to take the indicated step without foreseeing the minute details of the consequences.

Business as a Whole Does Not Seem to Benefit by Long Working Hours

"Of course, the individual manufacturer has always been accustomed to thinking of the maximum output at the height of prosperity as representing the opportunity to cash in on the 'velvet'; but since for one reason or another this maximum production seems inevitably to be met by the failure of consumer purchasing power, that 'velvet' begins to have a shoddy look. Here and there individual manufacturers may cash in on it, but it is quite evident that business as a whole does not.

"Seen from this point of view, the proposals for a shorter working week, with an increasing penalty for over-time, may be considered as a brake on the unwise and over-optimistic endeavor to reach out for profits that are non-existent for business as a whole. In a sense this policy should effect a "spread' of employment previous to, and in anticipation of, a let-down in business. The result might be to minimize materially the rigors of a depression.

"Another way of looking at it is from the angle of the 'labor reservoir' which a certain cold-blooded type of economist has always considered to be a desirable provision for industrial progress. This proposal provides a reservoir, which is employed instead of unemployed, and is ready to be drawn on at any time that industry is willing to pay the price in cumulative over-time.

"In many industries it will probably be difficult to make this forty-hour proposal effective except by trade organizations on an industry-wide basis.

"This rough proposal, not based on completed research, appears to be one of those hygienic measures that common sense, applied to our present incomplete knowledge, would indicate as a probably useful step in the preservation of our economic health."

Mr. Flanders further proceeds to point out that it seems highly desirable to maintain the wage rate

during a business crisis. "The only excuse for lowering wages," he says, "is the certainty that we are faced by a long-time lowering of the price level. There are many who now believe that we are entering another period of long-time decline in prices. If so, our best efforts to maintain wages will ultimately fail; but, also, if that is the case, nothing else that we can do can bring back the prolonged period of good business to which manufacturers and workers are looking forward. A long-time price decline, however, is a period of recession with a generally lower scale of industry, commerce, and standard of living." [Few would agree that there is any likelihood that we are entering upon such a period at the present time.]

Research, Development, and Replacement Work Should be Done Now

Mr. Flanders further emphasizes the idea that the time for research and development is during a period of depression; that is the time for experimentation, experimental use of a new product, building of new models, and the design and construction of new equipment, jigs, and fixtures for producing them. It is also a period when it is advisable to do maintenance and replacement work.

Replacement of machinery is a desirable policy during dull times. There are many firms who have gone further than this and have made most of their plant extensions at a low point in the business cycle. They have found that their capital expenditures are reduced in this way, as the work can be done at a time when costs are materially lower than during boom times. Furthermore, there is less danger of making unwise expenditures of this kind in the conservative atmosphere of a depression than there is in the hysterical stimulation of a boom.

Summing up the main points of his study, Mr. Flanders points out that a business depression is the time for vision and imagination; the recovery is the time for courage; while the boom is the time for sober judgment. The collapse of the boom, again, calls for patience. "Unfortunately," he says, "we have always tended to be one phase late, both in our appropriate action for the period of the cycle and the quality of the character that we manifest therein. We have waited on the collapse to exercise sober judgment; during the depression we have used such patience as we were able to muster; during the recovery we have enjoyed the excitement of vision and imagination; and we have delayed until the boom to display our courage—and that is just the time when we need it least.

"Fundamentally, the success of our manufacturing enterprises in meeting their individual problems in the future will lie in applying the proper activity and qualities of character to each of the four periods of the business cycle as they appear."

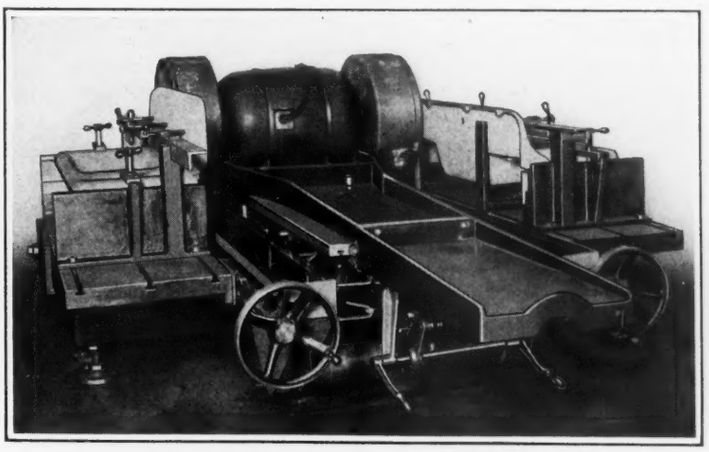
Where Metal-Working Machines are Used

The Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce has prepared a map of the United States on which is indicated the concentration of industries using metal-working machinery.

The map is colored by counties; each color represents a certain range in the value "added by manufacture" in the plants using metal-working machinery in that county. The value added by manufacture is as accurate a guide as can be devised to indicate the amount of metal-working machinery used in the manufacturing processes. Out of more than 3000 counties in the United States, 22 account for 48 per cent of the value added by manufacture in the industries considered. In all, 417 counties account for approximately 97 per cent of the value added by manufacture.

The industries covered are aircraft, agricultural machinery and implements, electrical machinery, engines, turbines, tractors, cash registers, foundry and machine shops in general, the automotive industry, hardware, machine tools and metal-working machinery, mechanical refrigerators, typewriters, and 29 miscellaneous industries.

A tabulated report is also prepared in connection with the map, which shows the number of plants in each industry group in each county and the total value added by manufacture in these plants. Copies of the map and of the tabulation are available for loan by applying to the Bureau of Foreign and Domestic Commerce, Washington, D. C.



From Fifty to Sixty Cast-iron Sinks per Hour are Ground by This Gardner Machine, which Feeds the Wheels Hydraulically Past the Work

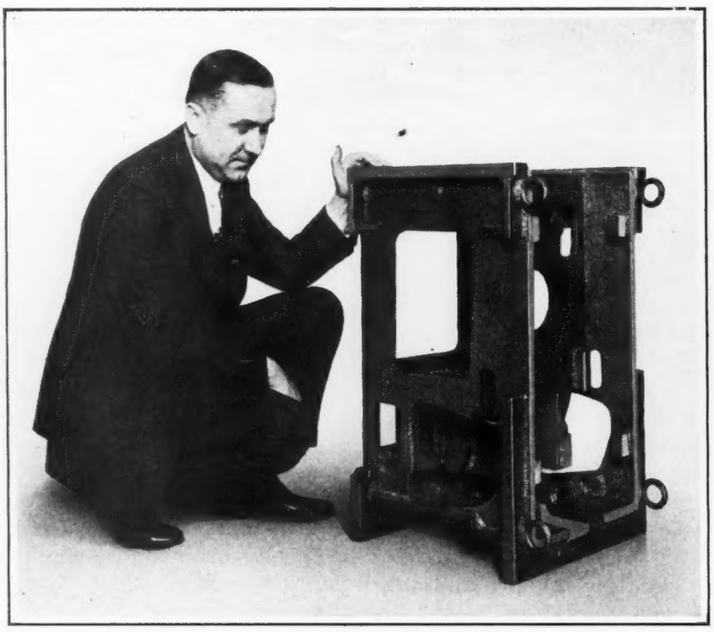
Making 400 Welded Jigs per Month

Results Obtained by a Large Concern that Constructs Jigs and Fixtures from Hot-Rolled Steel by Arc Welding

By J. R. WEAVER, Superintendent
Manufacturing Equipment Department
Westinghouse Electric & Mfg. Co.

TIME is a very important factor in industry today, especially in periods like the present, when it is necessary to produce at the lowest possible cost. The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has found that the time required for making jigs and fixtures can be considerably shortened by the use of arc welding, a process that the company has been using with satisfactory results for several years. A thorough investigation as to the reliability and accuracy of arc-welded construction was carried on by the company before it was decided to use this process extensively for jigs.

Several jigs and fixtures were fabricated and tested for inaccuracies such as warpage, distortion, vibration, etc. This testing has been carried on for several years by periodically checking the fixtures constructed when the welded construction was first adopted. In no case was any serious disadvantage found. In fact, the maintenance cost of the jigs and fixtures thus produced has been less than for those of cast construction.



The Author Inspecting a Welded Jig of Approved Design

Today, this company is manufacturing all its jigs, fixtures, and special machine tools by the arc-welding method. This means that about four hundred welded jigs are produced per month. Several special machine tools are also built each month. As time is a very important factor in supplying jigs and fixtures for manufacturing purposes, it is found advisable to handle the welding work in the tool department. Complete construction of all jigs, fixtures, and machine tools is now under the jurisdiction of the tool-room, which is responsible for all operations from the selection of raw material to the completion of the job.

It is interesting to note that an arc-welded jig body or the frame of a machine can be delivered to the machining department in about the same time that it would take to make a pattern for casting the same part. It is also interesting to note that in many cases the cost of the base or machine tool part is about the same as the cost of the pattern.

The cost of welded jigs and fixtures, as compared with the cost of making the same parts from castings, has been thoroughly checked several times. In all cases, the investigations have shown that the welded structures are about 25 per cent less expensive. Fewer operations and reduction in the weight of the material needed for welded construction are responsible for the lower cost. Thinner material can be used for welded parts, as the materials used are of uniform strength; whereas, in the case of castings, a large factor of safety must be allowed to cover casting irregularities and possible flaws. The arc-welded jig is stronger, because it is possible to place the steel where the working stress demands strength.

On the line of work referred to here, only one or a few jigs or machines of one type are made, so that if castings were employed, a pattern would only be used once, or, at the most, only a few times. Naturally, under such conditions, the pattern shop will not produce a pattern designed to reduce the required machining operations to a minimum. Hubs and bosses will generally be cast solid, or with an extra amount of stock, in order to lessen patternmaking difficulties. This extra material is lost and must be removed in the machine shop, all of which means additional expense. In the case of a fabricated jig, fixture, or machine tool, no more allowance for finish is made than is necessary for cleaning up the surface. As a rule, this is 1/8 inch or less, except for very large work, in which case an allowance of 1/4 inch is made for finishing.

It must be realized, of course, that jigs and fixtures must be designed for welded construction in order to keep the cost as low as possible. The design must lend itself to standard structural steel shapes and plates. A designer must know this method or type of construction so that he can take advantage of all its possibilities without losing any of the qualities desired.

Establishing Standards for Welded Construction

The Westinghouse Electric & Mfg. Co. has had considerable experience on welded construction in the manufacture of some of its standard products. As the company had a number of trained welders and welding supervisors, it was not difficult to set up a standard of design for jigs, fixtures, and machine tools. This standard was incorporated in a book of standards which was distributed to all the tool designers for their information and instruction in designing such products.

This, with some instructions from the welding supervisors, quickly gave the tool designers the information desired, and the advantages from this type of construction were realized in a very short time. The standard sheets used to show the various types of welds and size of bead for such work were shown in MACHINERY, February, 1930, page 533. In order to avoid delay due to stock material shortage, another sheet was provided which shows the standard sizes of steel most generally used. When bar stock is not suitable, the part is cut to size from a plate by means of an acetylene torch.

The same general principles, as applied to the construction of jigs and fixtures by arc welding, described in this article, apply to the construction of machine frames in general, and especially to the construction of machine tool frames and bases. In November MACHINERY, Mr. Weaver will present an article showing numerous examples of frames and bases designed for arc welding, indicating the possibilities of this method of construction. The expense of patterns for special machine tools is usually high, and the welding process is especially advantageous in the case of machines where only one or a few are built of one type. The time of delivery can also be shortened by the welding process.

Separate Lay-Out and Welding Sheets

The lay-out of the jig or fixture is made without any reference to welding. The designer makes a separate sketch which indicates how the welding is to be done. This gives complete information for manufacturing the jig. The welding sketch gives, in detail, the various sizes of material that are to be used, and also indicates the amount or size of the welding bead. With the work laid out in this manner, there is no misunderstanding between the shop and design rooms, and time values can be set readily by using the information available on the sheets.

The material used is hot-rolled steel, which is comparatively inexpensive. When good wearing surfaces are necessary, they are made from tool steel, hardened and attached to the jig by means of screws, bolts, or in the case of bushings, by pressing the parts into machined holes. In cases where chips are likely to become embedded in the feet of jigs or fixtures, it was found advisable to make the feet of a low grade of tool steel, heat-treated, and welded to the jig. When the jig is annealed to remove all strains, these feet are drawn to a scleroscope hardness of 45 to 50. The feet thus provided are much harder than the ordinary cast-iron feet, and yet are soft enough to be machined.

Assembling, Welding, and Annealing

Various parts of the jig body or machine tool part are assembled by a mechanic, who squares them up properly and clamps them in place, after which they are tack-welded sufficiently to hold the parts together. It is desirable that the man doing such work be well versed in welded construction work. Only sufficient welding is done at this time to insure holding the parts in place. After this, a welder joins all the parts securely by welding. Thus, the cost of welding is kept at a minimum.

In order to remove all strains and to prevent any distortion, all jigs and fixtures are annealed. This is done by heating them in a furnace to a temperature of about 1000 degrees F. and then allowing them to cool in the air.

Sand-Blasting and Painting

In order to maintain the appearance of the jigs and fixtures, it was found desirable to sand-blast all fabricated parts after annealing. This removes any loose particles or scale, and prepares the surface for painting. All the parts are spray-painted before any machining is done. The machining of jigs and fixtures of this type is no different from the methods used in machining cast jigs, except that less material is removed. The machining time is about 10 per cent less for welded jigs than for those of cast construction.

* * *

Safety Congress and Exposition

The Twentieth Annual Safety Congress and Exposition, conducted under the auspices of the National Safety Council, 20 N. Wacker Drive, Chicago, Ill., will be held at the Stevens Hotel, Chicago, October 12 to 16. The three groups of the National Safety Council cooperating in the Congress and Exposition are the Metals Section, the Automotive and Machine Shop Section, and the Power Press Section, representing about 1700 different industrial plants. A great number of papers will be read pertaining to safe practices in shops and factories and methods of accident prevention. At the Safety Exposition more than a hundred exhibitors will display safety appliances.

Notes and Comment on Engineering Topics

According to construction records, 145,742 parts were used in the assembly of a Boeing tri-motored passenger transport plane. Of this total 60,383 parts were produced at the factory from special drawings, while the remainder, or 85,359 parts, included bolts, nuts, rivets, and similar parts.

As has been frequently pointed out, the photo-electric tube may be used for turning off and on the light in factories whenever the intensity of daylight falls below a certain predetermined minimum. The photo-electric tube is now also used for controlling street lighting, Albany, N. Y., being probably the first city to so apply the new device. As soon as a certain degree of darkness prevails, regardless of the hour of the day, the photo-electric tube operates a relay, which, in turn, supplies power to throw a switch that turns on the street lights. As soon as a sufficient amount of daylight reappears, the contact is broken and the switch opens, turning off the lights.

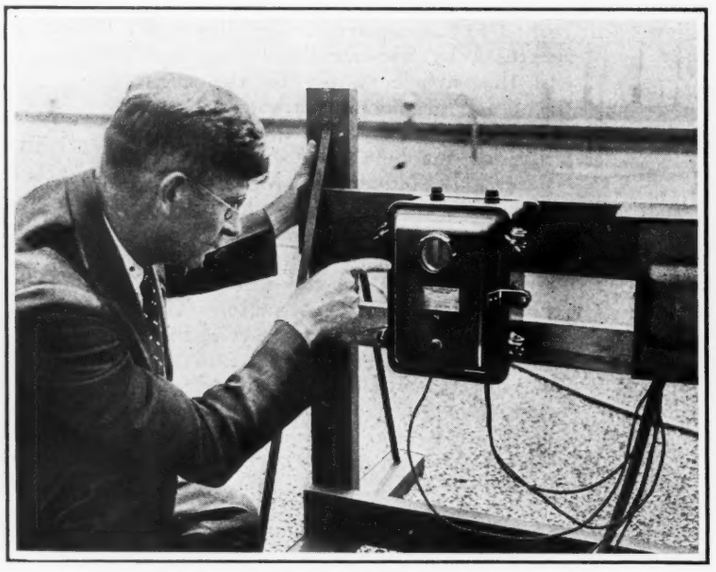


Photo-electric Relay Mounted on the Roof of a Building in Albany, N. Y., Showing Window that Admits Light Rays to the Sensitive Photo-electric Tube by Means of which the Street Lights are Turned off and on in Accordance with the Intensity of Daylight

---

The effect of wind resistance in automobile transportation, especially at high speeds, was pointed out at the recent meeting of the Indiana Section of the Society of Automotive Engineers. It was stated that a certain type of sedan car with a 125-horsepower engine would be capable of a maximum speed of 80 miles per hour. If this car were equipped with a 200-horsepower engine, its maximum speed would be about 94 miles per hour; in other words, a considerable increase in power would increase the speed by only a small percentage, due to the wind resistance.

On the other hand, it was pointed out that with the 125-horsepower engine it would be possible to obtain a maximum speed of 108 miles per hour if a stream line roadster body, specially designed for low wind resistance, were substituted for the sedan body.

A wind tunnel for testing model planes, which is claimed to be the largest in commercial operation in the world, has recently been completed by Berliner-Joyce Aircraft Corporation at Dundalk, Md. The tunnel is housed in a brick building constructed especially for the purpose.

The mouth of the entrance of the tunnel is 16 feet square and narrows down to a circular throat 7 1/2 feet in diameter. Beyond this throat the model to be tested is hung upside down on a very delicate balance. Air is sent roaring through the tunnel at a speed of 110 miles per hour by a four-bladed propeller 12 feet 6 inches in diameter, driven by a General Electric motor developing 224 horsepower.

Sensitive instruments register the movements of the model and measure the forces and moments exerted upon it while in the wind stream. From the data thus obtained engineers can determine the performance and stability of any plane that they may plan to build.

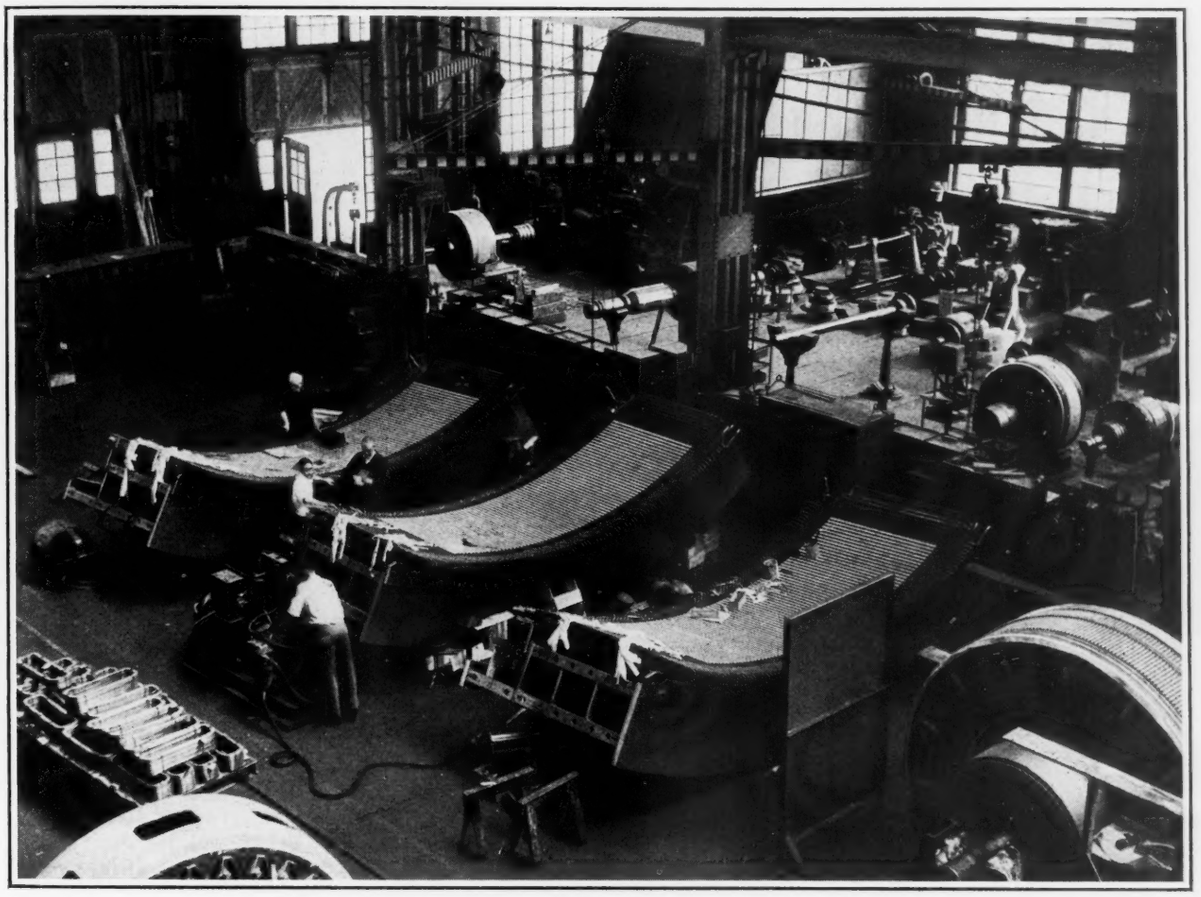
Not steam alone, but steam and horses furnished the traction power on the day that passenger service was inaugurated by the old Mohawk & Hudson Railroad, the first steam railroad in America, on September 24, 1831, just a hundred years ago. As recorded in a contemporary newspaper account.

the "powerful and effective engine" of English design, imported by the railroad, was not available for service, owing to a defect in a steam pipe, and the famous pioneer steam locomotive of American construction, *DeWitt Clinton*, with the assistance of seven horses, did the hauling on that notable occasion in the run between Albany and Schenectady.

The awesome "iron horse" pulled three coaches, while seven horses of ordinary vintage pulled seven additional coaches, each horse plodding along the rails pulling one coach. A newspaper account of the occasion stated that "the appearance of this fine cavalcade, if it can be so called, was highly imposing. The trip was performed by the locomotive in forty-six minutes, and by the cars drawn by horses in about an hour and a quarter." On the return trip, which is mostly down hill, the locomotive pulled five cars besides the tender, performing the trip at the rate of 19 miles an hour.

The American Standards Association has just announced that the 1931 edition of the National Electrical Code has been approved by the Association, following the submittal of the code by the National Fire Protection Association. Copies of the code may be obtained through the offices of the National Board of Fire Underwriters in New York, Chicago, and San Francisco, and also from the American Standards Association, 29 W. 39th St., New York City.

News comes from England of the development of a new process known as the "thermo-zinc" rustproofing method, developed by the Curtis Duramin Industries, Ltd., Park Royal, London, N.W. 10. It is claimed that this process for rustproofing ferrous materials has many advantages over methods previously employed. The details of the process have not been made known, but it consists in applying a zinc coating. The thickness of the coating can be varied within fairly wide limits and can be conveniently controlled. Articles all the way from light springs to heavy forgings can be handled, and the coatings adjusted to meet the requirements. Until further information about the process becomes available, it is, of course, difficult to judge its value, but the claims made for it seem to warrant attention.



A Small Part of One of the World's Largest Hydro-electric Generators in Process of Construction at the Schenectady Works of the General Electric Co. The Three Sections Shown Form One-half of the Stator Frame for a 77,500 K. V. A. Generator. The Weight of the Complete Stator, with Punchings and Windings, is 176 Tons

Hydraulic Type Fixtures Speed up Diamond Boring

Fixtures Designed to Insure the Rigidity and Precise Location Essential in Boring to Close Tolerances

By C. A. BIRKEBAK, Mechanical Engineer
The Ex-Cell-O Aircraft & Tool Corporation
Detroit, Mich.

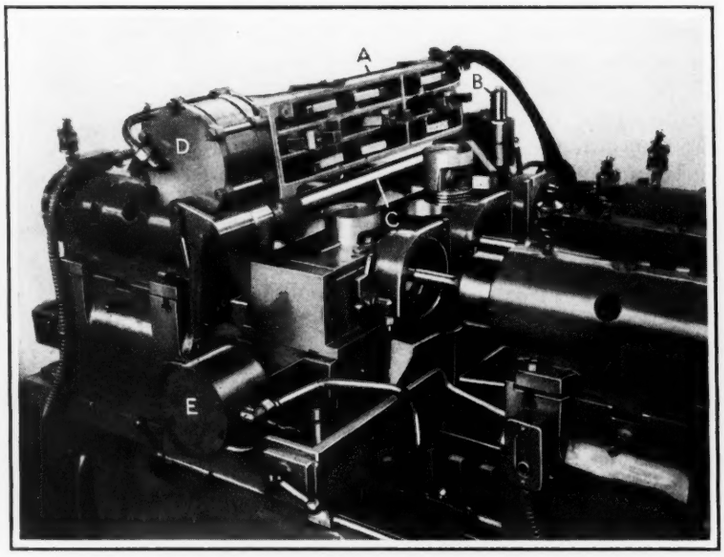


Fig. 1. Fixture for Diamond Boring Machine which Automatically Locates and Clamps Three Automobile Pistons

TWO hundred and sixty automobile pistons per hour is the output of two diamond boring machines of the type shown in Fig. 1, operated by one man. Each machine rough- and finish-bores the piston-pin hole to the specified size, straightness, and roundness within a tolerance of plus or minus 0.0001 inch. This high production is obtained by using hydraulically operated equipment for automatically locating and clamping the pistons in the fixture and for feeding the fixture to the rough- and finish-boring spindles. Six boring spindles, three roughing and three finishing, enable three pistons to be finished at each cycle of the machine. The pistons are made of an aluminum alloy, and the piston-pin holes have a nominal diameter of 1 inch.

The work fixture of this equipment, as well as all others to be described, was designed by the Ex-Cell-O Aircraft & Tool Corporation for application to the boring machine that this concern placed on the market some months ago for use with either diamond or tungsten-carbide tools. (See November, 1930, MACHINERY, pages 229-230.)

After the operator has loaded three pistons into the fixture illustrated in Fig. 1, he presses a button at the front that controls an automatic six-way hydraulic valve. The first action of this valve is to operate the cylinder at the back of the machine so as to lower top *A*, which contains the clamping mechanism. This is accomplished as the teeth of rack *B* are pulled downward in mesh with a pinion

Fig. 2. Hydraulic Fixture Equipped with Equalizing Clamps that Insure Concentric Boring of Cluster Gears

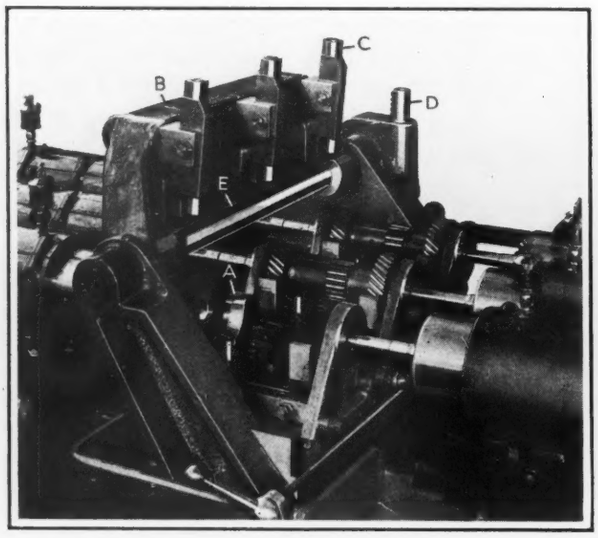
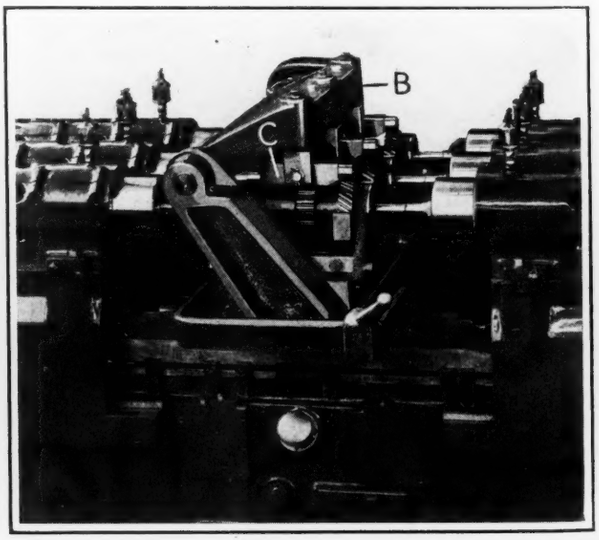


Fig. 3. View of the Cluster Gear Fixture Shown in Fig. 2, with the Top in the Loaded or Clamped Position



on shaft *C*. Top *A* is keyed to shaft *C* and swivels with it.

When this action has been completed, locating fingers in the fixture base are moved forward by cylinder *E* to align the rough piston-pin holes with the boring spindles. This movement of the locators also automatically locks the table and operates the valve so that the machine cannot be started while the locating is in progress. As soon as the pistons are accurately positioned, a third cylinder *D* operates, clamping the pistons from the inside of the skirt. The hydraulic piston in cylinder *E* then makes its return stroke, thus moving the locators out of the way and starting the table on the operating cycle.

In this cycle, the table traverses rapidly toward the left to bring the first piston-pin holes in the work up to the rough-boring spindles, slows down for rough-boring these holes, advances rapidly to bring the second holes to the rough-boring spindles, slows down for boring these holes, reverses at the rapid traverse rate to carry the pistons toward the finish-boring spindles at the right or opposite end of the machine, slows down for finish-boring the first holes, advances rapidly to the right to bring the second set of holes to these spindles, again slows down to the finish-boring feed, reverses at the rapid traverse rate to carry the fixture back to the middle of the machine, and stops for reloading.

As the table reaches the center of the machine, it automatically closes a switch, again starting the automatic six-way valve. Immediately, the clamps are released and the top of the fixture swings open. At the same time, a cam mechanism operates a plunger under each piston, which pushes the pistons about 2 inches above their seats, so that they can be easily removed. These plungers recede when new parts are to be reloaded.

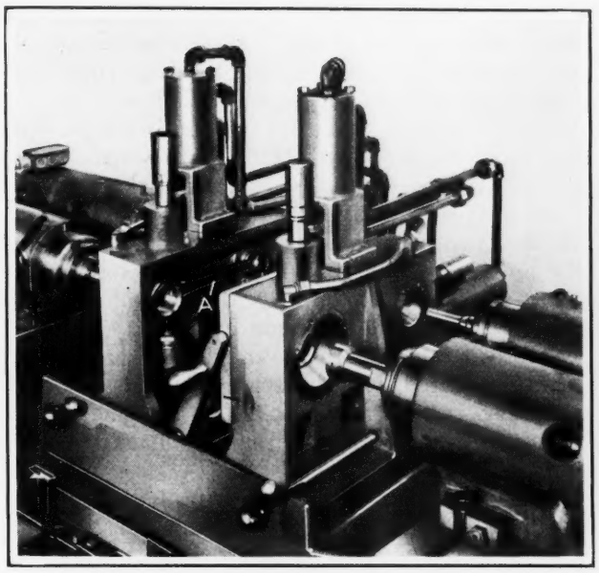


Fig. 4. Duplex Fixture for Diamond-Boring Connecting-rods, which are Accurately Located on Three Centers

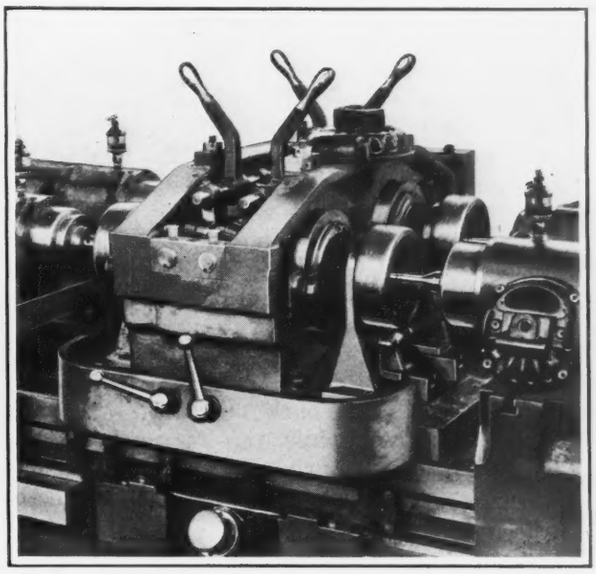


Fig. 5. Another Double-end Fixture for Boring Two Motor End Frames while Two Other Frames are Loaded

Cluster Gears are Located from the Ground Tops of Their Teeth

Another hydraulically operated fixture, designed for use in boring phosphor-bronze bushings assembled in the ends of cluster gears, is illustrated in Fig. 2 in the open or loading position. Fig. 3 shows the same fixture in the closed or boring position. Three cluster gears, 8 inches long, are machined at the same time, the production averaging 100 parts per hour. The bushings have a specified diameter of 1.000 inch, and must be bored to size within plus or minus 0.0003 inch. They are 2 1/4 inches long.

Before these cluster gears reach the diamond boring machine, they are hobbed on centers, broached from these centers after hardening, and then ground on the outside diameter from the same centers. Consequently, the gears can be accurately located from the outside diameter in semicircular nest blocks *A* for the diamond boring. Individual micrometer adjustments provide for aligning these nest blocks with their corresponding boring spindles.

When three cluster gears have been loaded in the nest blocks, and a button is depressed to actuate a hydraulic valve, lid *B* swings downward from the position shown in Fig. 2 to that shown in Fig. 3. As this occurs, an equalizing clamp *C* is lowered, which spans each cluster gear and holds it securely for the operation. Lid *B* is operated by a hydraulic cylinder through rack *D* and a pinion on shaft *E*.

When the gears have been clamped, the table moves toward one set of spindles for boring the bushings in the corresponding ends of the gears.

It then reverses to carry the gears to the second set of spindles for boring the bushings in the opposite ends. Finally the table returns to the center of the machine, where it stops for reloading.

Connecting-Rods are Located on Three Centers

Connecting-rods are bored at both ends by means of the fixture shown in Fig. 4. While one rod is being bored in either side of this fixture, another rod is being loaded at the opposite side. With this arrangement, a production of 170 connecting-rods per hour is obtained. The babbitted crank end has a nominal diameter of 2.250 inches, while the bronze-bushed piston-pin end has a specified diameter of 0.875 inch. Both holes must be bored to size within plus or minus 0.0002 inch.

One connecting-rod may be seen at *A* mounted on the left-hand unit of the fixture, the second rod being held at the back of the right-hand unit. Each of these connecting-rods is located by means of centers which engage two center holes drilled in the bolt lugs of the crank end and a third center hole drilled in the piston-pin end. The center hole in the piston-pin end is in line with the arm of the connecting-rod and at right angles to the center holes in the large end. One center hole in the crank end is held accurately as to depth from the center of the bore.

The lower center on the crank end of each unit is adjustable to facilitate setting up after grinding the centers, while the other two centers are mounted in sliding plungers. These are controlled by a hydraulic cylinder. The back pull of the movable centers is positive, while the forward push is against an adjustable spring tension. Individually controlled hydraulic devices move the centers of the two units.

When a connecting-rod is placed in either side of the fixture, it rests on the lower center at the crank end and in an approximate nest at the piston-pin end. The operator then turns the handle of a two-way valve, and as the hydraulic pressure is released, the movable center above the crank end of the rod moves downward slowly and seats itself on the work under a spring tension of 15 pounds. A 1/8-inch further movement of the hydraulic piston operates a plunger that locks the center sleeve solidly. As soon as this cylinder has completed its action, a cylinder at the back of the fixture advances the center that enters the center hole in the piston-pin end for accurately locating and clamping the rod.

With the two cylinders operating in succession as described, the crank end of the connecting-rod governs the end location of the rod. When the two-way valve is turned to release the finished part, both pistons in the hydraulic cylinders return simultaneously to their starting positions.

A feature of this equipment is that when the operation is in progress a conical stream of water is directed around the front of the boring quills. To baffle the water and completely enclose the unit of the fixture that is in operation, there is a hinged plate *B* which is moved back and forth against the two fixture units as the operator loads them. The swiveling shaft of this plate operates a two-way valve that controls the flow of the cutting compound, so that the closed unit receives the full flow, and the water is not directed to the open side.

Accurate Rings Insure Proper Location of Circular Parts

In Fig. 5 is shown another double-sided fixture, designed for loading two motor end frames on one side while bronze bushings are being bored in two similar frames on the opposite side. As in the previous example, each side is operated independently through a two-way hydraulic valve. The motor end frames are located by seating their finished periphery in locating rings, a circular dowel fitting the inside of the frame. Each locating ring is only 0.0005 inch larger than the maximum outside diameter of the frame. A micrometer adjustment provides for aligning the locating rings vertically in relation to the boring spindles.

After two frames have been placed in the locating rings on either side of the fixture, they are held in position by three clamps. Each set of these clamps is operated by a hydraulic cylinder, rack, pinion, and shaft running the length of the fixture. The four levers seen extending above the top of the fixture are used for quickly removing the parts from the circular dowel seats by hand.

Water manifolds are mounted in front of the parts to be bored. As the boring quills enter these manifolds, they are subjected to a cone-shaped stream of water, the same as in the fixture just described.

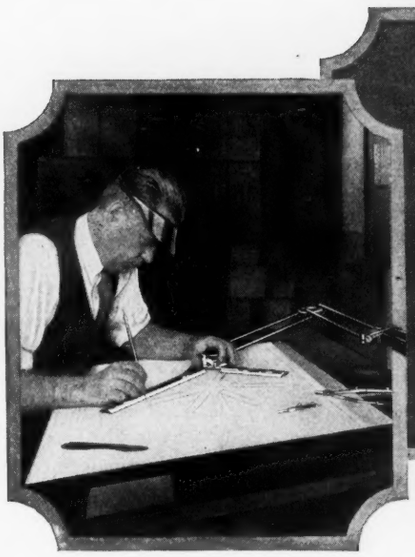
This equipment is used for boring holes in bushings from 1/2 to 1 1/16 inches in diameter. A combination of frame sizes can be bored at one time, depending upon production requirements. The average production is 240 frames per hour.

* * *

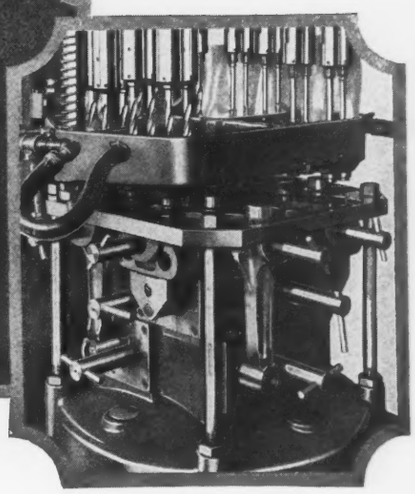
Softening Hard Spots in Castings and Forgings

By W. E. WARNER

Hard spots sometimes encountered in castings and forgings make it impossible to machine the parts satisfactorily until they have been softened by annealing. The writer has successfully adopted the method here described for softening such spots. This method is particularly applicable to very large parts where only one or two hard spots are found on the surfaces to be machined. First, the hard spot is marked and a mold of damp fire-clay built around it, leaving the hard area exposed. The flame of an oxy-acetylene torch is then played on the hard spot until it reaches a light red heat. The flame is next adjusted to give as low a temperature as possible. After heating in this way, the torch is withdrawn and the hard spot covered with hot sand or ashes, so that it will cool down slowly.



Design of Tools and Fixtures

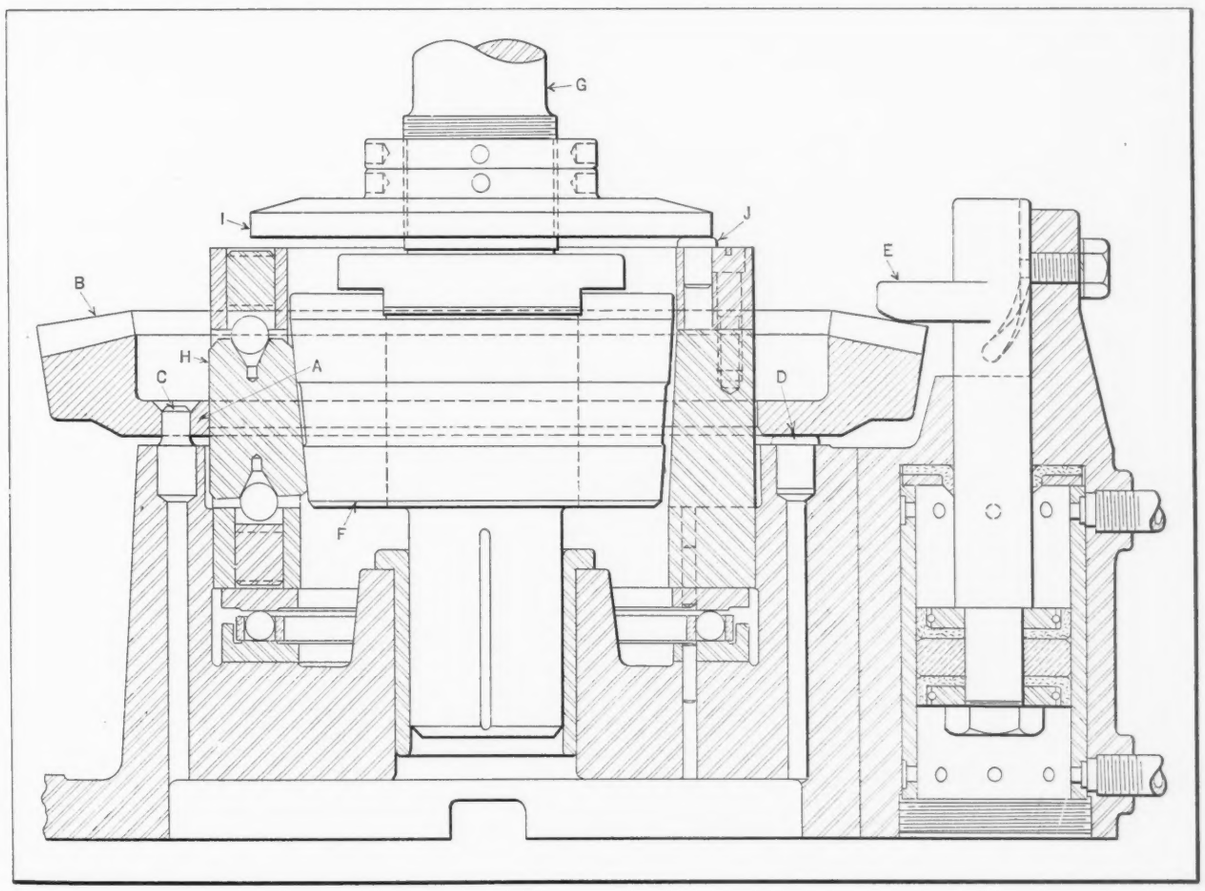


Finishing the Bore of Ring Gears by Rolling

By C. F. STAPLES, Birmingham, Mich.

The rolling fixture shown in the accompanying illustration is used for finishing the bore *A* of the ring gear *B* to the required diameter. The application of the rolling method to this job resulted in reducing the costs from $5 to $1 per 100 gears. The rolling fixture is used both before and after the gears are heat-treated, the operations being as follows:

The gear blank is machined all over; the bore *A* is broached and then rolled, 0.005 inch of metal being left for finish-rolling. Next the gear blanks



Fixture for Rolling Bore of Ring Gear to Size

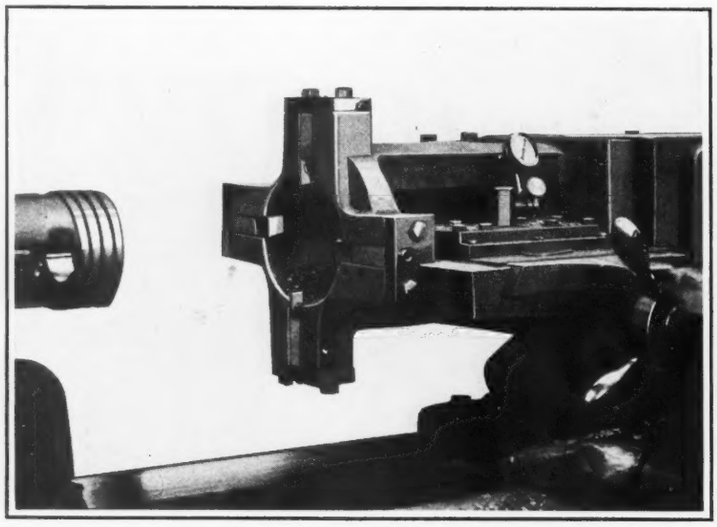


Fig. 1. Turret Tool-block in which Turning and Grooving Tools are Incorporated

are copper-plated and the teeth cut, after which they are carburized and hardened. The final operation of rolling is then performed, bringing the bore *A* to the required diameter.

The gear is located in the fixture by two pins *C* and rests on buttons *D*, being held down by two clamps *E*, which are operated by air cylinders. The master roller *F*, fitted to the pilot *G*, which is held in the drill press spindle, is lowered into the nest of small tapered rollers *H*. The tapered master roller *F* is driven at a speed of 80 revolutions per minute, and serves to expand and rotate the small tapered rollers *H*. This expanding action continues until the adjusting collar *I* strikes the buttons *J*. After coming to this stop, the spindle is allowed to rotate for about 1/2 minute.

This rolling operation produces round holes that are accurate within plus or minus 0.0005 inch, and has a tendency to correct any out-of-roundness in the gear, although it is not a "cure-all" and will not round up gears that have been badly warped in the heat-treating process. The small rollers *H* are made of a high-carbon alloy steel and require regrinding after rolling the bores of about three thousand gears. The bores of approximately ten thousand gears can be finished before these rollers require replacing.

Turning and Grooving Tool for Pistons

By CHARLES C. TOMNEY, Chief Tool Designer
Brunswick-Kroeschell Co., New Brunswick, N. J.

Turning the outside diameter and cutting the four ring grooves in compressor pistons is accomplished in a turret lathe by means of a special tool-block secured in the turret. This tool-block, as shown in Figs. 1 and 2, consists mainly of a hollow casting, at one end of which is cast a spider. In the spider are secured four tools for turning the outside diameter. With this arrangement, the four tools cut simultaneously and permit a rapid feed to be employed.

One side of the casting is open, and a slide carrying three grooving tools is mounted on a projection adjacent to the opening. The slide is operated by a star-wheel, secured to a fine-thread feed-screw. Attached to a post on the slide is a dial gage which is used for checking the depth of the grooves.

At the rear of the tool-block is a circular projection which is a slip fit in the turret hole and serves to locate the block central with the lathe spindle. The block is fastened to the turret face by means of four cap-screws, which pass through the holes *A*, Fig. 2.

A pilot is also provided in the block to support the cutting tools. The pilot is a sliding fit in a through hole in the block, and is prevented from turning by a screw *D* which engages a slot cut along the right-hand end of the pilot. The pilot is started into the finished hole in the piston by hand

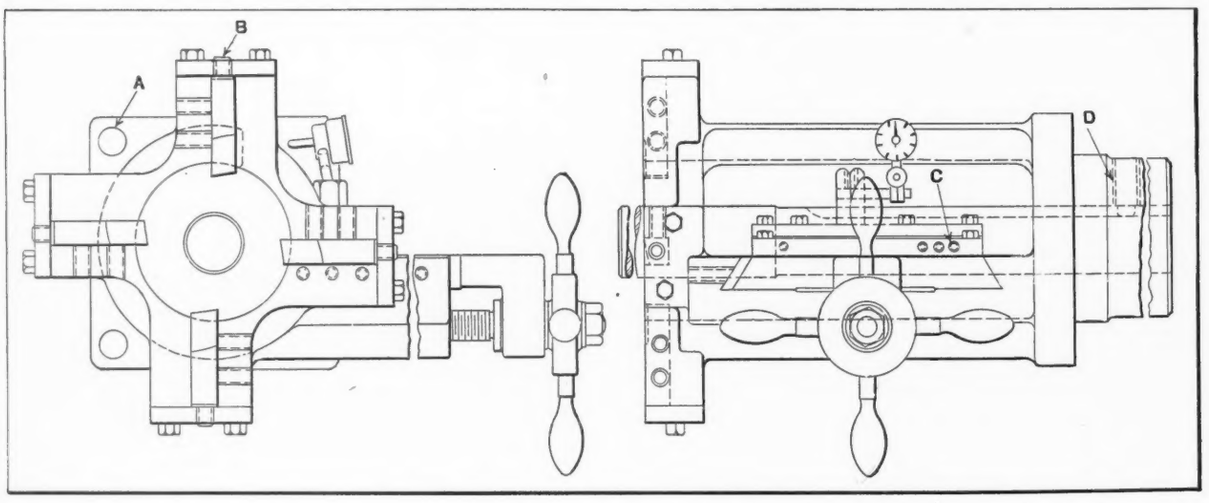
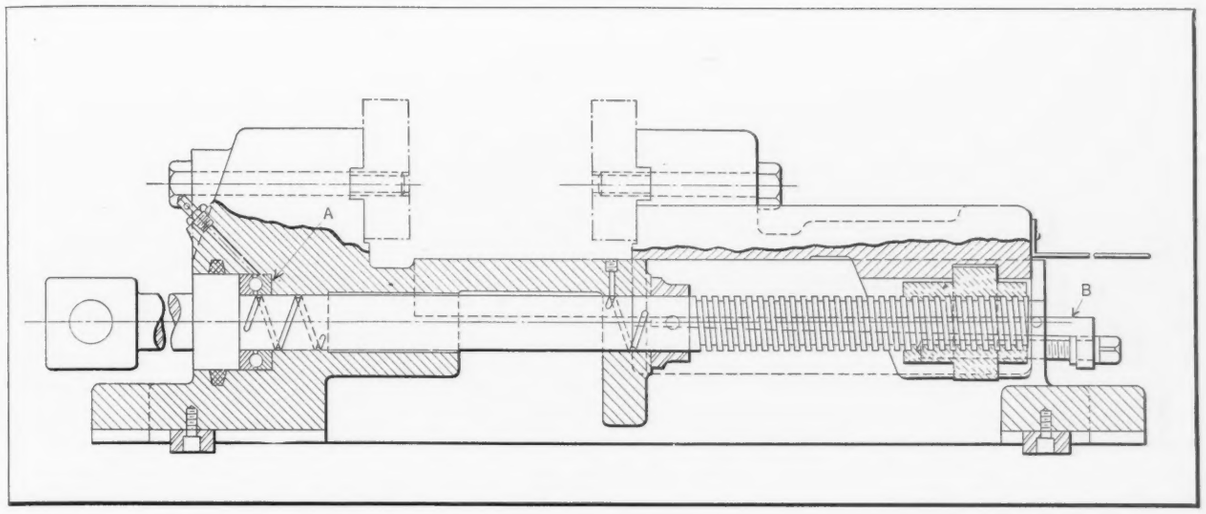


Fig. 2. Construction of Multiple-operation Tool-holder Shown in Fig. 1



Design of Milling Vise which Enables the Work to be Loaded and Clamped from the Same Side of the Cutters

just before the tool is fed to the work. The bore in the end of the piston does not extend clear through, and, as the tool feeds forward, the pilot is forced back into the block. The turning tools can be set to the proper depth by screws *B*, while the grooving tools are adjusted by means of the screws *C*.

For setting the grooving tools the required distance from the end face of the piston, a gage (not shown) is used in connection with a finished pad on the tool-block. To set the turning tools, a ring gage, which is a slip fit over the pilot, is employed. This gage is 0.015 inch larger than the finished diameter of the piston, and a feeler gage 0.0025 inch thick is used between the point of the tools and the gage. Thus, 0.020 inch is allowed for subsequent grinding.

By the use of this tool-block, ten minutes is saved for each piston over the time taken with previous methods of doing this work. As 1200 of these pistons are made per year, this amounts to an appreciable saving.

Milling Vise Operated from Solid Jaw End

By HANS SCHMIDT, East Orange, N. J.

In the vise shown in the illustration, the clamping is done from the solid jaw end. This arrangement facilitates many heavy milling operations, especially those done on machines of the duplex type, because the work can be loaded and clamped from the same side of the cutters. If a standard vise were used on this type of machine, it would be necessary to load and clamp the work on different sides of the cutters unless the vise were located on the machine table so that the sliding jaw would take the thrust of the cutters. The difficulty with this method, however, is the resulting chatter, which produces a poor surface.

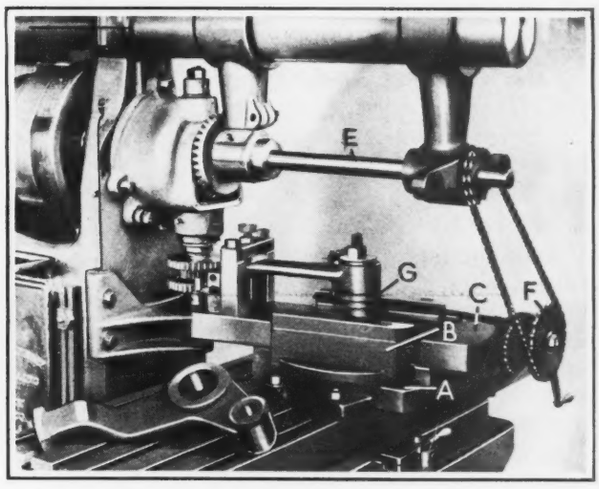
In general construction, the vise shown is somewhat similar to the standard design, except that the clamping screw passes through the solid jaw end of the vise. The thrust of the screw is taken by the ball bearing *A*. Wear between the loose jaw and the body of the vise can be compensated for by the tapered adjustable gib *B*. The working parts are covered to exclude chips.

Power-Driven Fixture for Milling Curved Surfaces

By A. E. GRANVILLE, Knox, Ind.

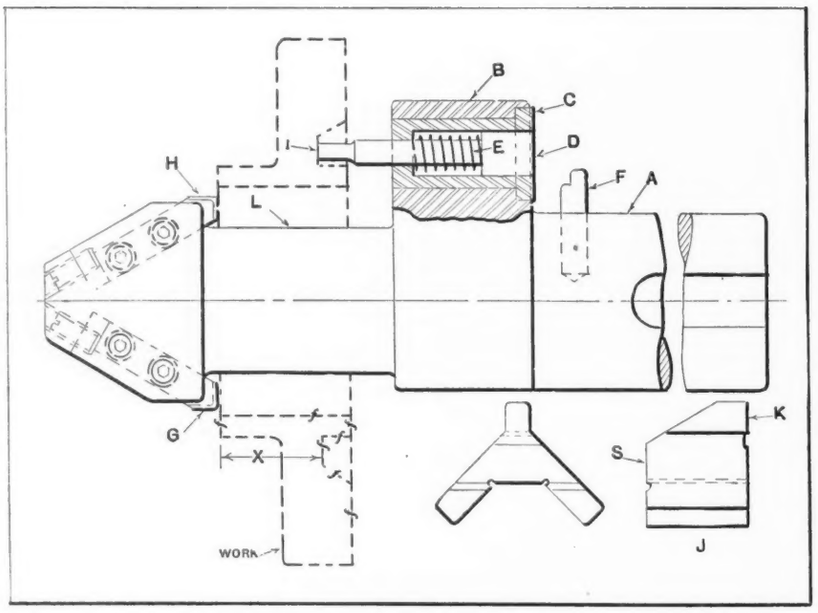
The curved surface and two side faces of the segment of a rocker arm used in a special automatic machine are milled simultaneously by means of the set-up shown in the illustration. The fixture is of the swivel type and consists of the base *A*, bolted to the machine table, the swivel *B*, and the adjustable work-table *C*.

A vertical milling attachment equipped with gang cutters is provided for this job, and one of



Rotary Fixture Used for Milling a Curved Surface and Two Straight Faces Simultaneously

the bevel gears in the attachment meshes with a bevel gear on the auxiliary shaft *E*, causing this shaft to rotate with the cutters. On the outer end of shaft *E* is fastened a sprocket wheel which drives the sprocket *F* on the fixture. Sprocket *F*, in turn, transmits a rotary feeding movement to the swivel through reduction gears, a worm, and worm-gear segment, the gear segment being secured to the swivel.



Back-facing Tool with Flush Pin Gage

To facilitate returning the work-table to its starting position after each milling cut, provision is made for quickly disengaging the worm from its gear segment. In loading the work, one end of the rocker arm is located on the work-table by the plug *G*. This plug may be adjusted in a slot cut in the work-table to suit rocker arms of various lengths. The segment end of the rocker arm is clamped in position by set-screws in posts driven into the work-table.

Curved surfaces of various radii can be milled in this fixture by simply loosening the gibs on the swivel and adjusting the work-table the required amount. Although designed for milling rocker arms, this fixture can be utilized for other similar milling jobs by merely attaching suitable clamping units to the work-table.

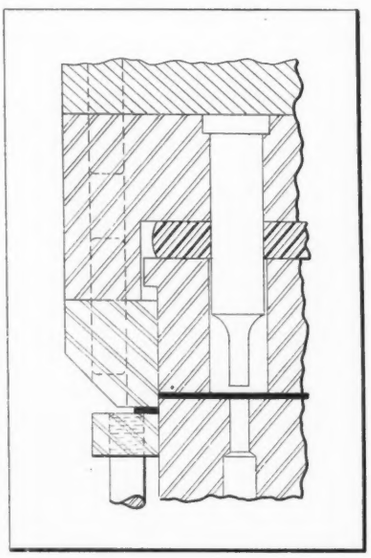
Back Facing Tool with Special Stop

By JOSEPH E. FENNO
Belleville, N. J.

The tool here illustrated is used in a turret lathe for rough- and finish-facing the end of the hub on the flange shown in dot-and-dash lines. In machining this part, it is necessary that the dimension *X* be held within very close limits of accuracy. This was accomplished through the use of the hardened steel finger flush pin *D*, which is a slide fit in the hardened bushing *C*. Bushing *C* is a press fit in the plug *B* on bar *A*. The roughing cutter *G* and the finishing cutter *H* are adjusted by means of backing-up screws.

The regular lathe stop is used to locate the tool for the roughing cut, and the flush pin gage for the finishing cut. In the latter case, the operator simply moves the carriage to the rear until the surfaces *D* and *C* are flush, while the end *I* of the pin rests on the bottom of the groove in the work. The flush pin, when not in use, is normally held back against the stop-pin *F* by spring *E*, so that it clears the work when the cutter is fed across the face of the hub.

The gage *J* is used for setting the facing cutter *H* in the correct position with relation to the end *I* of the flush pin. The vee formed by the inner angular faces locates the gage on the bar at *L*. With the gage in this position, the cutter is adjusted until its cutting edge and the end of the pin *I* just touch the gaging surfaces at *S* and *K*, respectively. The surfaces *D* and *C* should then be flush.



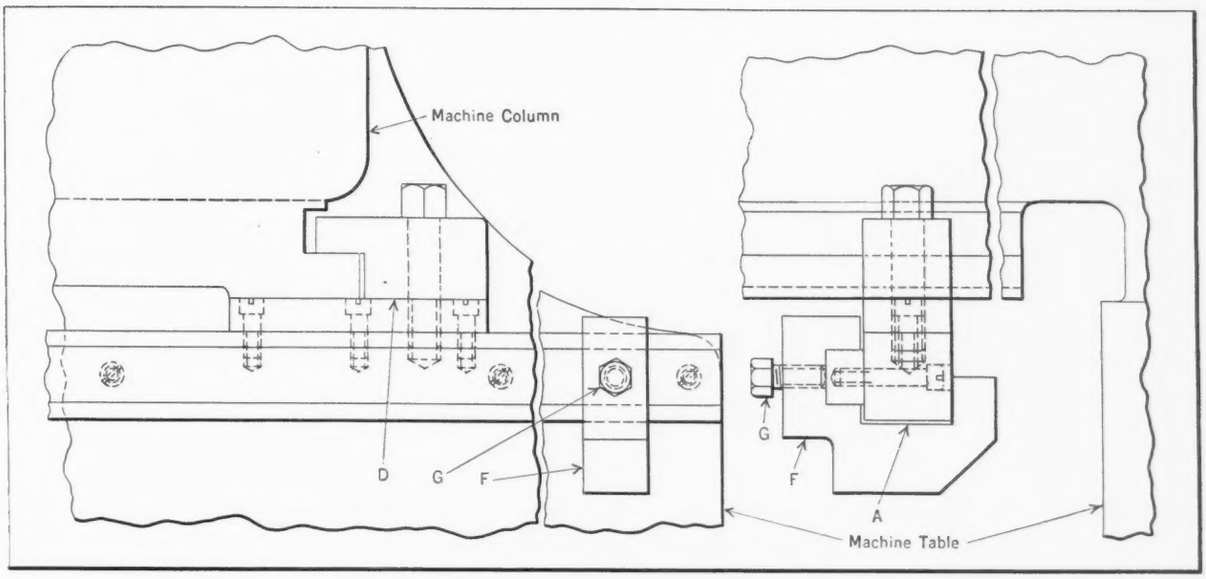
Die in which Punches are Made Inoperative by Increasing Shut Height of Ram

Die for Blanking Pieces With or Without Pierced Holes

By GEORGE L. PYRITZ
Indianapolis, Ind.

The article "Device for Rendering Piercing Punches Inoperative" on page 524 of March MACHINERY shows a rather clever arrangement for raising the punches. However, the arrangement described in the following is a simpler means of obtaining the same results.

In the illustration is shown part of a die in which the piercing punches are made short enough so that the piece can be blanked without the piercing punches entering the strip. To blank and pierce, the shut height of the press is reduced so that the punches enter the die.



Stop Clamped to Column of Multiple Drilling Machine to Locate Jigs on the Table

One advantage of this construction is that the punches can be pressed into the punch-block, thus avoiding the use of set-screws, which are likely to push the punches out of alignment. In addition, the simpler construction reduces the cost of the tool.

Adjustable Stop for Jigs Used on Multiple Drilling Machine

By E. F. EBERHARD, Bridgeport, Conn.

In drilling and tapping on multiple drilling machines, the jig is usually located in different positions along the table in order to complete the operations on the piece. In many cases, stops are not provided for locating the jig in the proper position under each set of drills, and it is necessary for the operator to align the drills with the bushings by eye. In other cases, angle-irons secured to the table of the machine serve as stops for the jig. This is a somewhat awkward arrangement, however, and has been improved upon by the writer, as shown in the illustration.

The stop illustrated consists of a long bar *A*, which is clamped to the column of the machine by the two straps *D*. This bar may be adjusted vertically to suit the projections on the jig being used. Two sliding stops *F* are secured in place on the bar by means of set-screws *G*, and they may be adjusted to suit the different positions of the jig. Frequently, more than two settings are required to finish the drilling operations on a piece. In this case, extra stops *F* are provided. All parts of this arrangement are made of machine steel, except the bar *A*, which is made of cold-rolled steel in order to reduce the number of machining operations on it.

Fixture for Gaging Six Different Surfaces with One Dial Indicator

By HALVOR ANDERSON, Kenosha, Wis.

In the gaging fixture shown in Fig. 2, six different surfaces on a piece are gaged by means of one dial indicator. A master of the part being gaged is shown in Fig. 1. This part has an elliptical bore which must be centrally located between surfaces *A* and *B* and also between the surfaces *C* and *D*. All readings are taken from the gage shown at *A* in Fig. 2. These readings are transmitted to the dial gage by levers which actuate plunger *B*.

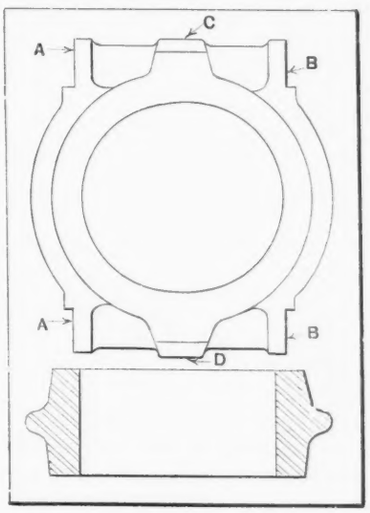


Fig. 1. Master of Part Gaged in Fixture Shown in Fig. 2

In adjusting the fixture for use, the master is placed over the block *O*, and surfaces *A* (Fig. 1) are forced against the stationary points *D*. In doing this, the part of the bore farthest from these points comes in contact with the lever *E*, which is pivoted at point *F*. The lower end of this lever engages a slot in plunger *B*, so that as the upper part of the lever moves to the left, the lower end forces the plunger and dial button to the right.

With the master in the position mentioned, the gage is set so that the indicator registers zero. Incidentally, all other points gaged must register zero. The master is now moved to the right so that the surfaces *B* (Fig. 1) will be in

contact with the stationary points *G*. The upper end of lever *H* will now be in contact with the part of the bore farthest from the points *G*, and the lever will be forced to the right. Lever *H* is pivoted at *I*, and its movement is transmitted through the intermediate lever *K* to the plunger *B*, forcing the latter toward the right.

Lever *K* engages a slot in an insert in plunger *B*, and two screws *L* are provided to adjust this insert until the indicator registers zero on the dial. This adjustment is shown in the detail at the right.

The master is now moved laterally until the bore comes in contact with the plug *O*, causing the surface *C* (Fig. 1) to come into contact with the lever *Q*. This lever is pivoted on the shaft *R* to the bottom of which another lever *S* is attached. In the end of this lever is a screw *T* which bears against the end of the main plunger *B*, so that the latter is forced to the right when the lever *Q* is oscillated by the master. With the master held in contact with the plug *O*, the screw *T* is adjusted until the indicator reads zero. To set the opposite surface *D* (Fig. 1), the same procedure is followed, the corresponding levers and the adjusting screw being similar to those just described.

In this way, the readings for all six surfaces at *A*, *B*, *C*, and *D* (Fig. 1) will register zero on the indicator. After all the adjustments have been made, the master is removed and the actual gaging operation of the work is begun.

In order to keep plunger *B* against the ends of the levers, a spring *U* is provided for holding the plunger toward the left. Another spring *V* is employed for holding levers *E* and *H* in their proper positions. This spring, however, is made of smaller gage wire than that shown at *U*. The rapid operation made possible by this design was necessary, as the gaging fixture was used at the machine in which the oval holes were bored, and this operation was very rapid.

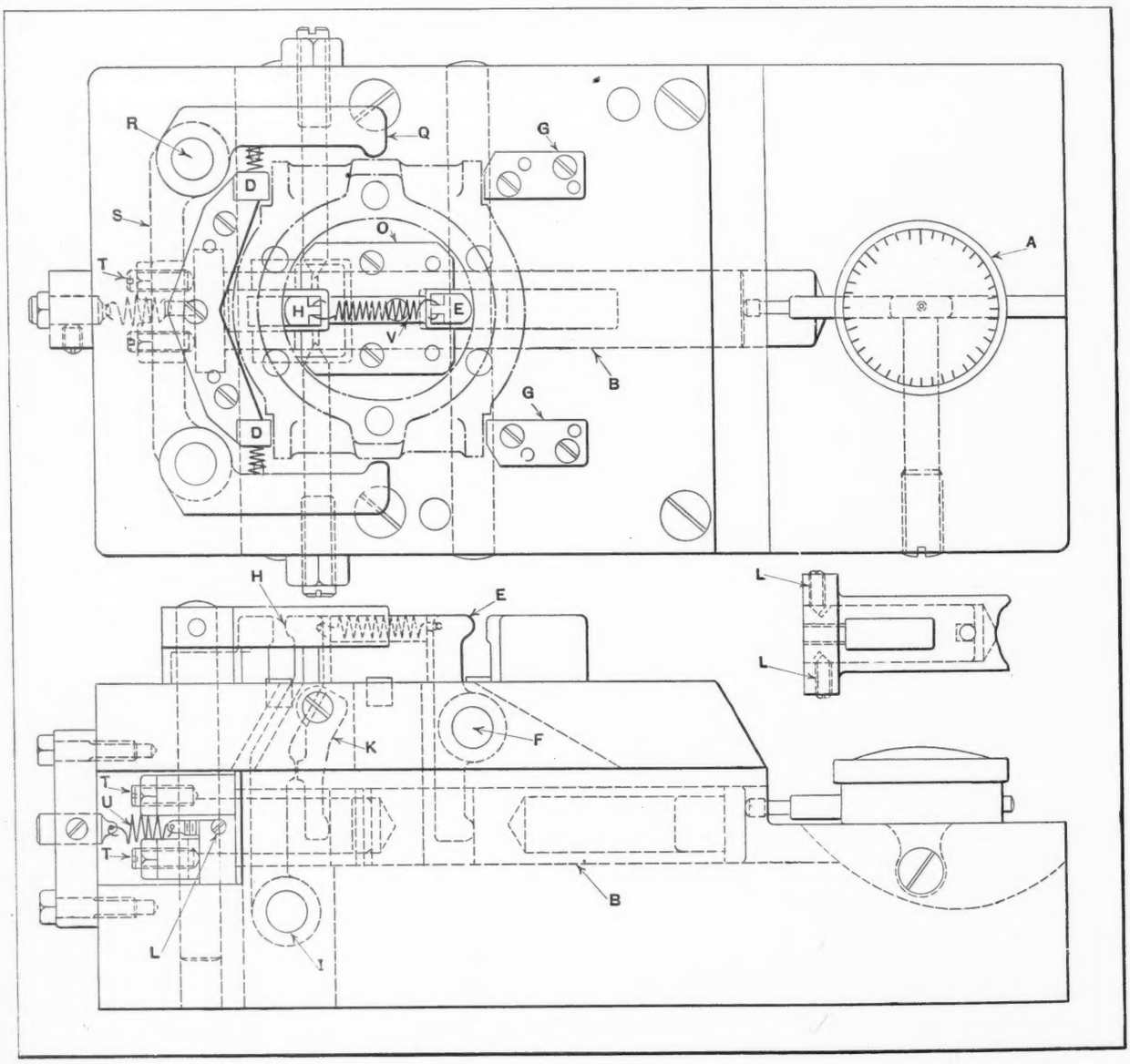


Fig. 2. Gaging Fixture Employing a System of Levers to Eliminate the Use of More than One Dial Gage

STOCK FOR SCREW MACHINE PRODUCTS

Length of Piece and Cut-off Tool	Feet per 1000	Length of Piece and Cut-off Tool	Feet per 1000	Length of Piece and Cut-off Tool	Feet per 1000	Length of Piece and Cut-off Tool	Feet per 1000	Length of Piece and Cut-off Tool	Feet per 1000	Length of Piece and Cut-off Tool	Feet per 1000
0.050	4.2	0.225	19.0	0.400	33.6	0.575	48.3	0.750	63.0	0.925	77.7
0.055	4.6	0.230	19.3	0.405	34.0	0.580	48.7	0.755	63.4	0.930	78.2
0.060	5.0	0.235	19.7	0.410	34.5	0.585	49.2	0.760	63.9	0.935	78.6
0.065	5.5	0.240	20.2	0.415	34.9	0.590	49.6	0.765	64.3	0.940	79.0
0.070	5.9	0.245	20.6	0.420	35.3	0.595	50.0	0.770	64.7	0.945	79.4
0.075	6.3	0.250	21.0	0.425	35.7	0.600	50.4	0.775	65.1	0.950	79.8
0.080	6.7	0.255	21.4	0.430	36.1	0.605	50.8	0.780	65.5	0.955	80.3
0.085	7.1	0.260	21.8	0.435	36.6	0.610	51.3	0.785	66.0	0.960	80.7
0.090	7.6	0.265	22.3	0.440	37.0	0.615	51.7	0.790	66.4	0.965	81.1
0.095	8.0	0.270	22.7	0.445	37.4	0.620	52.1	0.795	66.8	0.970	81.5
0.100	8.4	0.275	23.1	0.450	37.8	0.625	52.5	0.800	67.2	0.975	81.9
0.105	8.8	0.280	23.5	0.455	38.2	0.630	52.9	0.805	67.6	0.980	82.4
0.110	9.2	0.285	23.9	0.460	38.7	0.635	53.4	0.810	68.1	0.985	82.8
0.115	9.7	0.290	24.4	0.465	39.1	0.640	53.8	0.815	68.5	0.990	83.2
0.120	10.1	0.295	24.8	0.470	39.5	0.645	54.2	0.820	68.9	0.995	83.6
0.125	10.5	0.300	25.2	0.475	39.9	0.650	54.6	0.825	69.3	1.000	84.0
0.130	10.9	0.305	25.6	0.480	40.3	0.655	55.0	0.830	69.7	1.010	84.9
0.135	11.3	0.310	26.1	0.485	40.8	0.660	55.5	0.835	70.2	1.020	85.7
0.140	11.8	0.315	26.5	0.490	41.2	0.665	55.9	0.840	70.6	1.030	86.6
0.145	12.2	0.320	26.9	0.495	41.6	0.670	56.3	0.845	71.0	1.040	87.4
0.150	12.6	0.325	27.3	0.500	42.0	0.675	56.7	0.850	71.4	1.050	88.2
0.155	13.0	0.330	27.7	0.505	42.4	0.680	57.1	0.855	71.8	1.060	89.1
0.160	13.4	0.335	28.2	0.510	42.9	0.685	57.6	0.860	72.3	1.070	89.9
0.165	13.9	0.340	28.6	0.515	43.3	0.690	58.0	0.865	72.7	1.080	90.8
0.170	14.3	0.345	29.0	0.520	43.7	0.695	58.4	0.870	73.1	1.090	91.6
0.175	14.7	0.350	29.4	0.525	44.1	0.700	58.8	0.875	73.5	1.100	92.4
0.180	15.1	0.355	29.8	0.530	44.5	0.705	59.2	0.880	73.9	1.110	93.3
0.185	15.5	0.360	30.3	0.535	45.0	0.710	59.7	0.885	74.4	1.120	94.1
0.190	16.0	0.365	30.7	0.540	45.4	0.715	60.1	0.890	74.8	1.130	95.0
0.195	16.4	0.370	31.1	0.545	45.8	0.720	60.5	0.895	75.2	1.140	95.8
0.200	16.8	0.375	31.5	0.550	46.2	0.725	61.0	0.900	75.6	1.150	96.6
0.205	17.2	0.380	31.9	0.555	46.6	0.730	61.3	0.905	76.0	1.160	97.5
0.210	17.6	0.385	32.4	0.560	47.1	0.735	61.8	0.910	76.5	1.170	98.3
0.215	18.1	0.390	32.8	0.565	47.5	0.740	62.2	0.915	76.9	1.180	99.2
0.220	18.5	0.395	33.2	0.570	47.9	0.745	62.6	0.920	77.3	1.190	100.0
										1.200	100.8
										1.210	101.7
										1.220	102.5
										1.230	103.4
										1.240	104.2
										1.250	105.0
										1.260	105.9
										1.270	106.7
										1.280	107.6
										1.290	108.4
										1.300	109.2
										1.310	110.1
										1.320	110.9
										1.330	111.8
										1.340	112.6
										1.350	113.4
										1.360	114.3
										1.370	115.1
										1.380	116.0
										1.390	116.8
										1.400	117.6
										1.410	118.5
										1.420	119.3
										1.430	120.2
										1.440	121.0
										1.450	121.8
										1.460	122.7
										1.470	123.5
										1.480	124.4
										1.490	125.2
										1.500	126.1
										1.510	126.9
										1.520	127.7
										1.530	128.6
										1.540	129.4

DIAMETERS AND TOLERANCES FOR NUT AND TAPPER TAPS

Adopted by Tap and Die Manufacturers

National Coarse Cut (Unground) Threads. Cut thread taps made to these specifications should, in the majority of cases, produce holes within the National Screw Thread Commission Class 2 Tolerances. Manufacturers of taps do not guarantee the size of the tapped hole, but only the size of the tap.

U. S. Standard Screw Threads			Tap Measurements—Cut (Unground) Threads					
			Major (Outside) Diameter			Pitch Diameter		
Size and Number of Threads	Major (Outside) Diameter	Pitch Diameter	Minimum	Maximum	Tolerance	Minimum	Maximum	Tolerance
1/4–20	0.2500	0.2175	0.2525	0.2550	0.0025	0.2180	0.2200	0.0020
5/16–18	0.3125	0.2764	0.3155	0.3180	0.0025	0.2769	0.2789	0.0020
3/8–16	0.3750	0.3344	0.3785	0.3810	0.0025	0.3349	0.3369	0.0020
7/16–14	0.4375	0.3911	0.4410	0.4440	0.0030	0.3916	0.3941	0.0025
1/2–13	0.5000	0.4500	0.5040	0.5070	0.0030	0.4505	0.4530	0.0025
9/16–12	0.5625	0.5084	0.5670	0.5700	0.0030	0.5089	0.5114	0.0025
5/8–11	0.6250	0.5660	0.6300	0.6330	0.0030	0.5665	0.5690	0.0025
3/4–10	0.7500	0.6850	0.7550	0.7590	0.0040	0.6855	0.6885	0.0030
7/8–9	0.8750	0.8028	0.8805	0.8845	0.0040	0.8038	0.8068	0.0030
1–8	1.0000	0.9188	1.0060	1.0100	0.0040	0.9198	0.9228	0.0030
1 1/8–7	1.1250	1.0322	1.1310	1.1355	0.0045	1.0332	1.0367	0.0035
1 1/4–7	1.2500	1.1572	1.2565	1.2610	0.0045	1.1582	1.1617	0.0035
1 1/2–6	1.5000	1.3917	1.5075	1.5120	0.0045	1.3927	1.3962	0.0035
1 3/4–5	1.7500	1.6201	1.7575	1.7630	0.0055	1.6216	1.6256	0.0040
2–4 1/2	2.0000	1.8557	2.0085	2.0140	0.0055	1.8572	1.8612	0.0040
2 1/4–4 1/2	2.2500	2.1057	2.2590	2.2650	0.0060	2.1072	2.1117	0.0045
2 1/2–4	2.5000	2.3376	2.5100	2.5160	0.0060	2.3396	2.3441	0.0045

Lead Tolerance

A maximum lead error of plus or minus 0.003 inch in one inch of thread is permitted.

Thread Angle Tolerances

Threads per Inch	Permissible Error in One-Half Angle	Total Permissible Error in Full Angle
3 1/2 to 4	Plus or Minus 30	Plus or Minus 45
4 1/2 to 5 1/2	Plus or Minus 35	Plus or Minus 53
6 to 9	Plus or Minus 40	Plus or Minus 60
10 to 20	Plus or Minus 45	Plus or Minus 68

What Effect Has Apprentice Training on Labor Turnover?

By C. J. FREUND, Apprentice Supervisor, Falk Corporation

THE main object of training apprentices is to increase the quota of skilled mechanics and to develop men who can qualify for promotion to foremanship and other positions of responsibility. But there are other favorable results, less tangible, although very important, that may be ascribed to apprenticeship.

For instance, employers often assert that the presence of apprentices in a plant tends to make other employes more steady and reduces the labor turnover for the plant as a whole. Data available in the office of the Milwaukee branch of the National Metal Trades Association seem to bear out this contention. Since 1920 a comparison has been made between the percentage of labor turnover in sixteen plants in which apprentices have been trained and in fourteen plants in which apprenticeship has never been established.

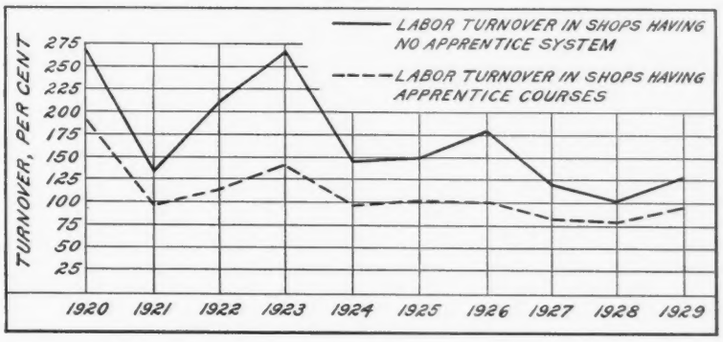


Chart Showing Effect of Apprentice Training on the General Labor Turnover in a Group of Thirty Factories

During all these years, the shops employing apprentices have averaged 60 per cent less labor turnover than the shops having no apprentices.

Of course, it is impossible to say that the reduced labor turnover is the result of apprentice training alone. Other factors may have played a part as well. However, there appears to be no difference in the two groups of shops except the presence of apprentices in one and their absence in the other. In both groups there are plants producing a varied line of products, and in both, plants that manufacture a limited line. In both groups are jobbing shops, and in both, semi-production shops. In both groups there are some comparatively young organizations and some corporations with a record of many years.

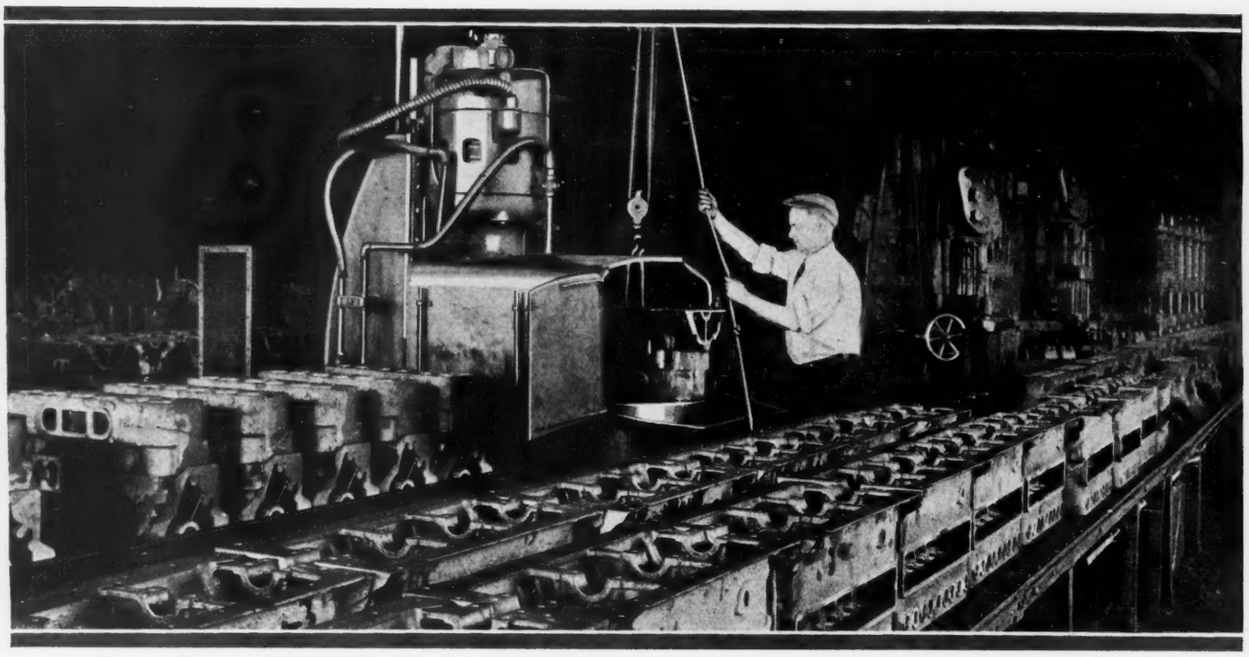
To one familiar with modern apprentice training methods, it seems only natural that the presence of apprentices in a plant should tend to make the regular employes more steady. When a number of young men are being carefully trained in an organization, the employes realize that the organization is developing from within. As the younger generation is coming along, the older man realizes that the employer will not be helpless if he leaves and will not, of necessity, have to engage him if he wishes to return.

But the principal reason why the presence of apprentices in a plant reduces labor turnover is that the employer must give the apprentices much personal attention, and as a result, unconsciously gives more individual attention to other employes, thus building up good will and promoting loyalty.

[This is the last of seven articles in which Mr. Freund has answered a number of the questions that frequently arise in the minds of manufacturers regarding the results that may be expected from an apprentice training program. Mr. Freund has pointed out that most of the objections raised to the training of apprentices are based on ideas that are not supported by the facts. He has shown that nearly all the popular conceptions as to the futility of training apprentices are erroneous. He has shown that manufacturers who have gone about this matter in a determined, carefully planned, common-sense manner have achieved most successful results. A general application of apprentice training throughout all our industries would not only help to solve many of our industrial and labor problems, but would go far toward remedying some of our social ills as well. Adequate training not only makes skilled men in industry, but creates better citizens as well. —EDITOR]

* * *

It is of interest to note that in 1895 the total number of motor vehicles in use in the United States was four. In five years, this number rose to 8000. The million mark was exceeded in 1913, and the 5,000,000 mark was reached in 1917. In 1921 there were over 10,000,000 motor cars registered, and this number was nearly doubled in 1925. In 1930, the total registration reached 26,500,000. Of this number 23,000,000 were passenger cars and 3,500,000 motor trucks.



Accurate Surface-Grinding of Castings

Typical Examples of Production Jobs Handled on Vertical Surface Grinding Machines

ACCURATE grinding of flat surfaces on large- and medium-sized castings, as described in this article, is accomplished on vertical surface grinders built by the Blanchard Machine Co., Cambridge, Mass. The heading illustration shows a No. 16 high-power machine employed in the cylinder block department of an automobile engine plant. Fig. 1 shows a close-up view of a cylinder block held on the 36-inch magnetic chuck with which this machine is equipped. The 20-inch cylinder wheel and the extended column used in grinding the bottom surface or the crank-case side of the cylinder block casting are also shown.

In the latest installations of this kind, an air hoist is used to transfer the cylinder blocks from the conveyor to the grinder. After the crank-case side of the cylinder block has been ground, the casting is placed on the conveyor again, and slid into a rolling fixture which turns it over. Following this, the casting is picked up by the air hoist and placed on another machine like the one shown in Fig. 1, which grinds the top side. The casting is then transferred to the conveyor which takes it to succeeding stations, where other operations are performed. The production rate on this job is fourteen cylinder blocks per hour; that is, the two machines grind twenty-eight surfaces per hour. The work is held to size within limits of plus or minus 0.0025 inch, and must be flat within 0.002 inch. The material is cast iron, and from 0.010 to 0.012 inch of stock is removed from each side.

The job of surface-grinding the sides of pump casings, illustrated in Fig. 2, is interesting because of the close limits held on this work, which is ground to the finished size from the rough castings. These casings are cast iron, and are 6 inches in diameter. About 1/16 inch of stock is removed from each side at the rate of 25 pieces per minute. The limits on this work are plus or minus 0.0005 inch.

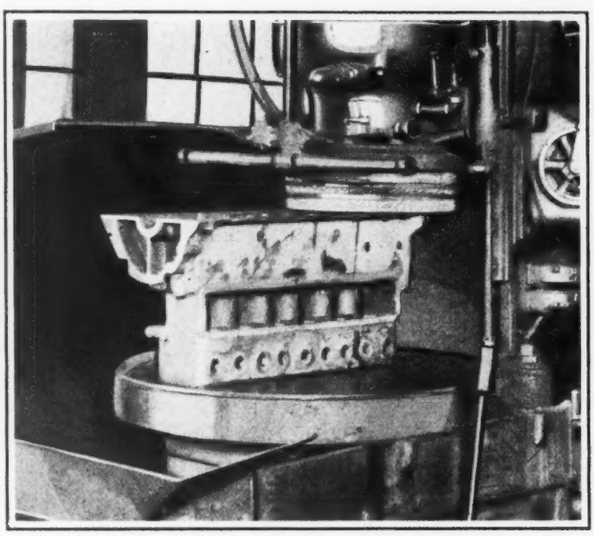


Fig. 1. Vertical Surface Grinder Equipped for Finishing Crank-case Side of Cylinder Block

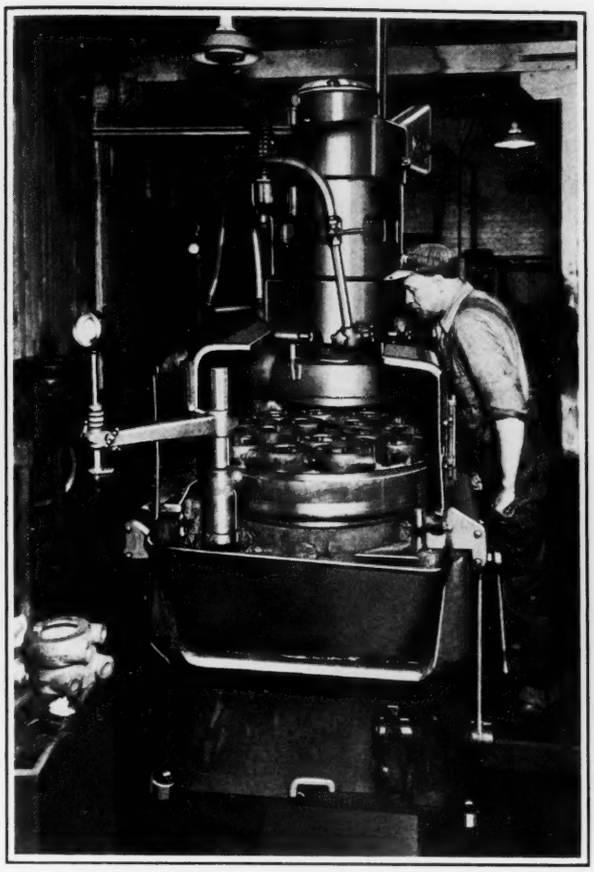


Fig. 2. Surface-grinding Pump Casings that Must be Held to Close Limits

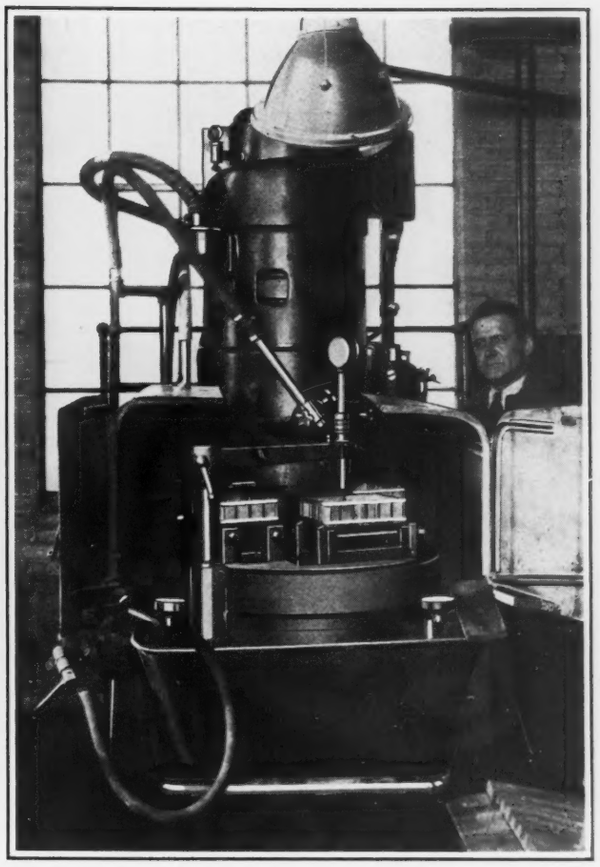


Fig. 3. Fixtures Employed on a Magnetic Chuck to Hold Non-Magnetic Parts

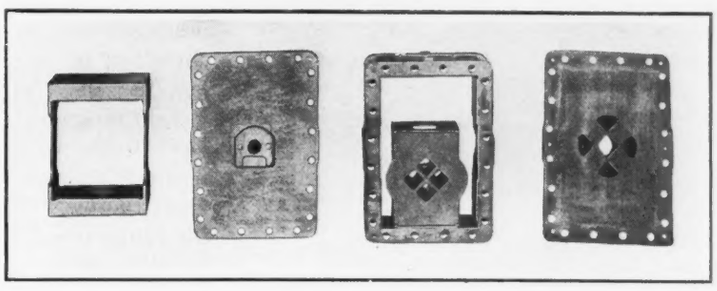
In Fig. 3 is shown a Blanchard grinder equipped for grinding a non-magnetic "Do-zinc" frame, which is an important part of a meter manufactured in large quantities for use in measuring gasoline. Four of these frames are clamped in fixtures, which are placed on the magnetic chuck. With this equipment, ten frames are finished per hour, both sides—twenty surfaces—being finished within limits of plus or minus 0.0003 inch.

The base, body, and cover of the meter shown in the three views to the right in Fig. 4 form an oil-tight box. All joint-forming surfaces of these members are ground on a Blanchard surface grinder and assembled without gaskets. The member consisting of the valve-guide and valve, shown to the left in Fig. 4, is also ground on one of these machines. This part and a small crank constitute the moving members of the meter. The successful functioning of the meter depends, more than anything else, on the absolute flatness and absence of friction between the sliding flat surfaces which are finished on the surface grinder.

It is of interest to note that the base, body, and cover of the meter, when assembled, are tested at an air pressure of 300 pounds per square inch. Every meter must withstand this test successfully in order to pass inspection. A test of this kind indicates the high degree of accuracy obtained by surface-grinding, as the parts tested are assembled without gaskets.

Other unusual applications of the surface-grinding principle will be described in coming numbers.

Fig. 4. Examples of Very Accurate, Surface-ground Parts for a Gasoline Meter



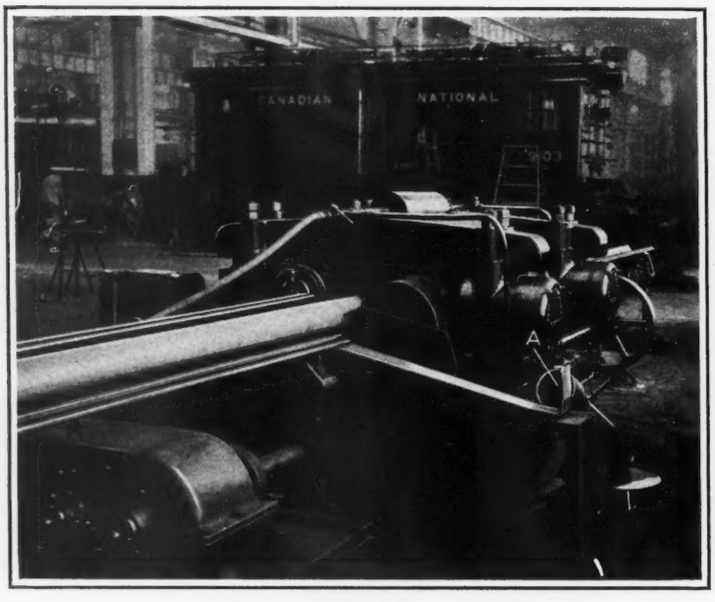
Special Tools and Devices for Railway Shops

Equipment Employed in Locomotive Repair Shops, Selected by Railway Shop Superintendents and Foremen as Good Examples of Labor-Saving Devices

Handy Method of Cleaning Boiler Tubes

Removing scale and dirt from used boiler tubes was a troublesome job in the shops of the Canadian National Railways before the present practice was adopted. The former method was to tumble the tubes in large barrels. When the new shop was erected in Montreal, straightening machines of the type shown in the illustration were installed for this purpose. As the tubes are fed through the rollers of this machine, the rolling action loosens all scale and dirt, and at the same time, straightens the tubes.

In removing a rolled tube from the table at the left-hand end of the machine, one end is inserted in pump *A*, which leads to the sewerage system. Water under a high pressure is then forced through the tube from the opposite end to remove the dirt.



Boiler Tubes are Cleaned of All Scale and Dirt as They Pass through this Straightening Machine

The machine illustrated handles boiler tubes from 3 1/2 to 5 1/2 inches in diameter. Other machines are used for smaller tubes. Each machine has three sets of rolls.

After the tubes have been cleaned and straightened as described, the worn-out ends are cut off and new sections of tubing are welded in place. O. H.

Safety Gasoline Pot for Cleaning Small Parts

By EDWIN G. JONES, Atlantic Coast Line Railroad Co. Tampa, Fla.

The cast-iron pot *A* shown in the accompanying illustration holds sufficient gasoline to clean a large variety of small parts handled in a railway shop. It is one of the best safety pots for this purpose that the writer has ever seen, and has been recommended by fire insurance inspectors. It is easy to make and is very convenient for the repair man.

The cover is raised by simply depressing foot-pedal *B*. Thus the repair man can use both hands for cleaning the work while the cover is held open by the foot-pedal. After the cleaning is completed, the foot is removed from the pedal and the lid is closed by means of a coil spring *C*. The top of the pot and the engaging face of the lid are machined to a close fit that is practically air-tight.

A locomotive chafing block or any other suitable casting found around the shop can be used for the container or pot *A*. Such castings have sufficient weight to keep them in place and do not have to be bolted to the bench. This feature facilitates cleaning the sediment from the pot. The upper jaw pin *D* or the hinge pin *E* can be removed so that the pot can be carried to the waste can

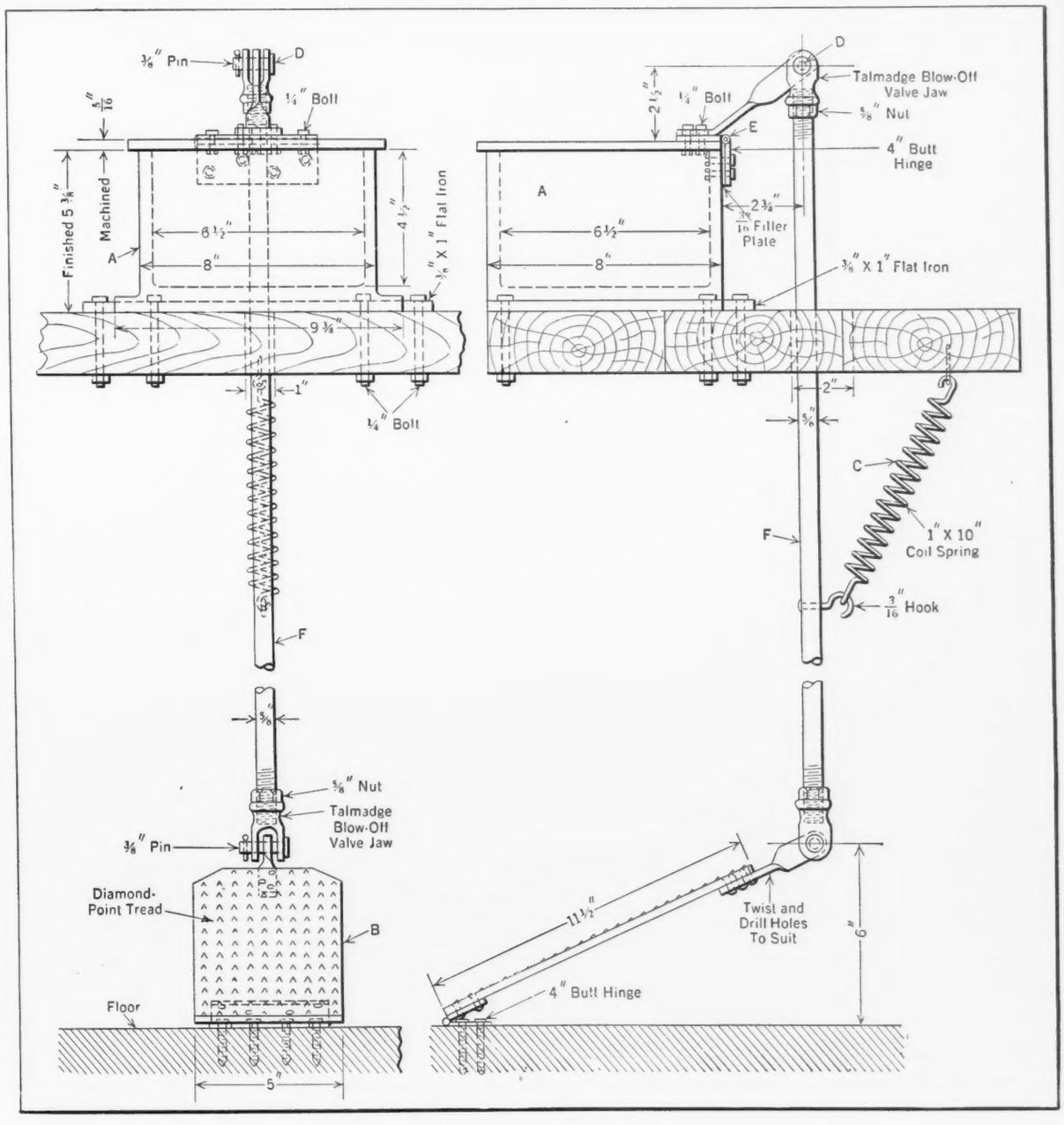
and emptied. The pot is held in position by a close-fitting frame or nest consisting of two side strips and one back strip made of 3/8- by 1-inch flat iron, bolted to the bench.

Two 4-inch butt hinges are used, one on the pot for the lid and the other on the foot-pedal. Two Talmadge blow-off valve jaws connect the rod *F* to the cover and the foot-pedal. The closing spring is 1 inch in diameter by 10 inches in length, and is made of 1/8-inch wire. Any suitable coil spring may be substituted, however.

The foot-pedal is made of 1/4-inch boiler plate, the top surface of which is roughed up with a diamond-point chisel to prevent the foot from slipping. A slot 1 inch wide by 2 inches long is cut in the bench to prevent the connecting-rod *F* from binding. This type of cleaning pot is safe, and requires very little gasoline. It should not, of course, be kept full. Very little gasoline is wasted through evaporation. This equipment is suitable for automobile shops, as well as railroad shops, and can be made up at small cost.

* * *

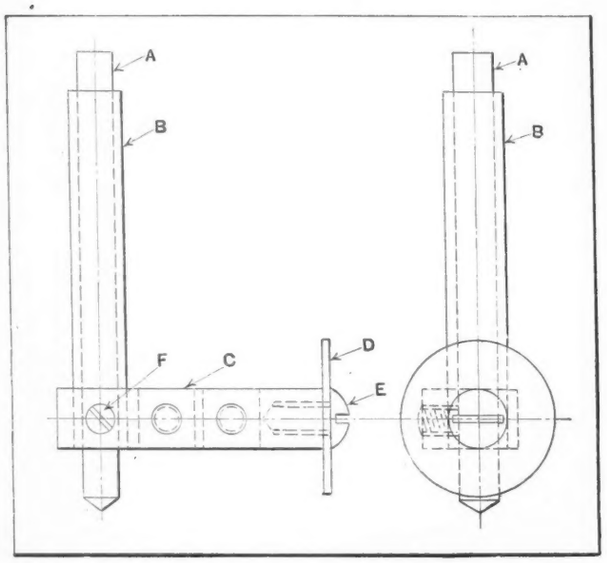
The Lewis Institute of Chicago, Ill., in cooperation with the American Machinery and Tools Institute, 40 N. Wells St., Chicago, has instituted a course for the training of skilled workers for the machinery and tool industry. A leaflet describing the course and stating the requirements for admission may be obtained by applying to the Lewis Institute.



Gasoline Pot with Close-fitting Cover Operated by Foot-pedal

Ideas for the Shop and Drafting-Room

Time- and Labor-Saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work



Trepanning Tool with Revolving Cutter for Cutting out Thin Abrasive Wheels

Salvaging Broken Abrasive Wheels

An ambitious tool-room apprentice salvaged a number of thin abrasive wheels which had been broken by making smaller wheels of various diameters from the pieces. An adjustable trepanning tool of the sweep design having a revolving cutter, as shown in the illustration, was made up for use in cutting out the small wheels.

Referring to the illustration, *A* is a piece of 1/4-inch round cold-rolled steel; *B*, a piece of Shelby tubing, which is a sliding fit over the 1/4-inch rod; *C*, a piece of cold-rolled steel drilled and tapped as shown; *D*, a separator disk taken from a worn out emery-wheel dresser, which turns freely on the screw *E*. Screw *E* is bottomed firmly in the tapped hole to prevent it from backing out. The tubing *B* and rod *A* may be held in any of the three holes in piece *C*, and thus it is possible to cut out wheels of three different diameters. The tubing and rod *A* are held in place by the set-screw *F*.

The arbor holes in the abrasive wheels are produced by the pointed end of the rod *A*, so that it is unnecessary to drill these holes previous to the cutting out operation. The wheels formed with this tool were used on a flexible-shaft grinder.

Ontario, Calif. H. R. HAGEMAN

Making Ink Erasures on Tracings

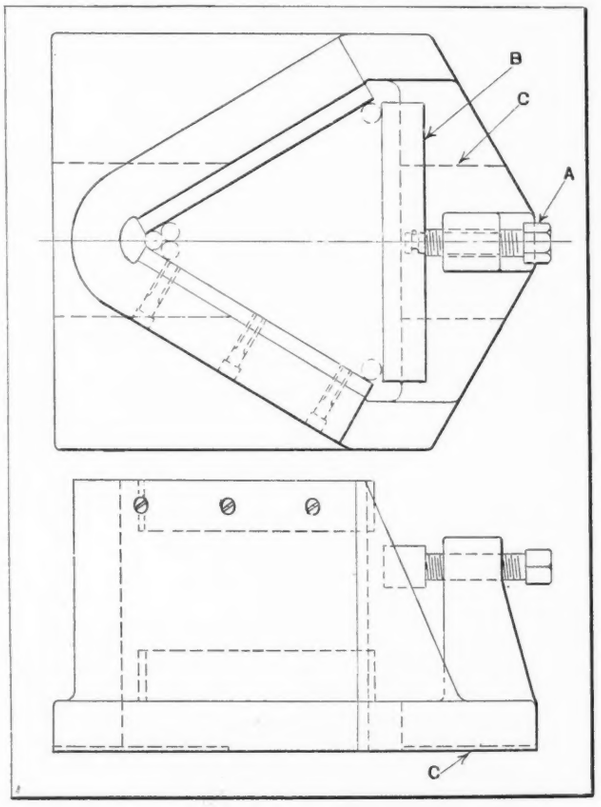
The following method is employed by the writer for making erasures on tracing cloth and has been found very effective. By placing a triangle or a piece of celluloid under the tracing cloth and rubbing very lightly with a pencil eraser, the ink line will gradually disappear without damaging the surface of the linen. Moreover, this procedure will not cause the ink to spread when new lines are drawn over the section erased. While this method of making erasures may be well known to many draftsmen, the idea may prove of value to others who have been using regular ink erasers.

Philadelphia, Pa. GEORGE A. FISCHER

End-Squaring Fixture for Pins and Short Shafts

Frequently it is necessary to square up the ends of short shafts, pins, or other cylindrical parts. The fixture shown in the illustration was designed to hold sixty-eight hardened shafts on a surface grinder while the ends of the shafts are being squared up with their longitudinal axes.

The clamping pressure is applied by the cap-screw *A* to the bar *B*, so that the parts are held



Fixture for Holding Sixty-eight Hardened Shafts while Grinding their Ends Square

securely in a group having the form of an equilateral triangle. The fixture may be designed for any cylindrical part and for use on a surface grinder, milling machine, or shaper, depending on the material and parts to be finished. The clearance groove *C* planed in the bottom of the fixture provides a clear passage for the coolant or cutting compound.

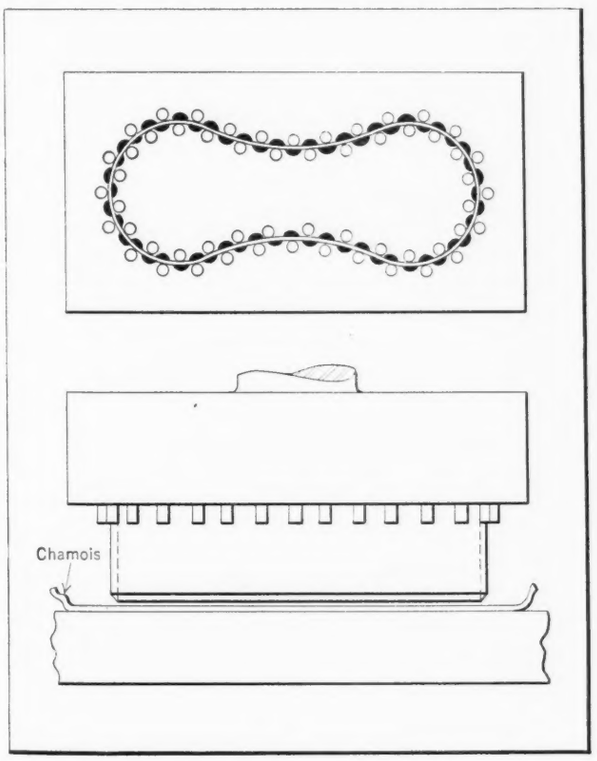
Toronto, Ont., Canada CLIFFORD CORNWALL

Die for Blanking Irregular Shapes from Chamois

A rather clever method of constructing a die for blanking chamois is shown in the illustration. The upper member of the die consists primarily of a beveled knife made of 1/32- by 1-inch spring steel. The knife is bent to the required contour and held in this shape on the punch-block by means of a series of 1/8-inch pins. The blade is then soldered to the punch-holder. The lower member of the die consists merely of a block of wood with the grain running parallel to the movement of the press ram.

In constructing this punch, a line representing the contour of the blank is first laid out on the face of the punch-holder. Holes are then drilled for the pins on each side of this line. The holes are located at a distance from the line equal to one-half the thickness of the blade. After the pins have been driven into the holder, the blade is inserted and soldered to the punch.

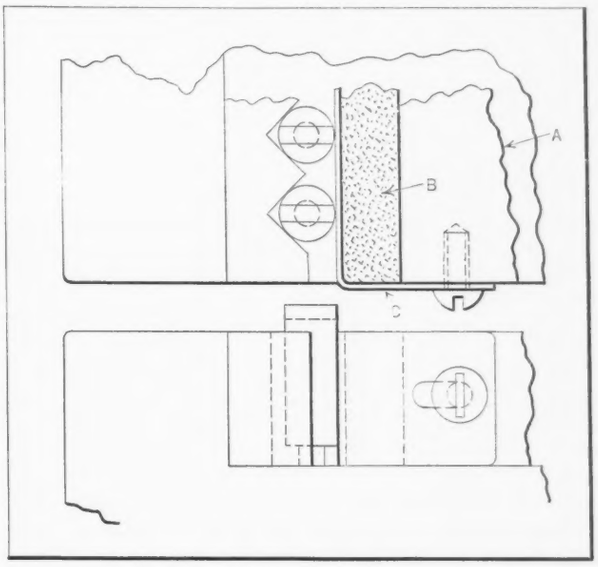
Philadelphia, Pa. CHARLES KUGLER



Construction of Die Employed for Blanking Irregular Shapes from Chamois

Simple Equalizing Arrangement for Milling Vise

Various types of equalizing arrangements have been employed for holding several pieces of work at one time in a milling machine vise. Some of these are more or less complicated, and in many cases, the cost of their construction does not warrant their use.



Milling Machine Vise in which a Rubber Pad is Employed to Obtain an Equalized Clamping Action

However, a simple method of obtaining the same results is shown in the illustration. The work is held in a series of V-grooves cut in the solid jaw, and is clamped in position for milling by means of the movable jaw *A*. On the face of this jaw a rubber pad *B* is held in position by means of a spring steel strip *C*, which, in turn, is secured to jaw *A* by two round-head screws passing through elongated holes in the strip.

As the jaw *A* is forced against the work, any variation in the diameter of the work is compensated for by the resiliency of the rubber pad. The chief function of the strip *C* is to prevent the pad from spreading excessively. As the work compresses the rubber, the steel strip slides on jaw *A*, the round-head screws moving in the elongated holes in the strip. It is best to use this type of jaw only on work of a light nature, as heavier work, under a heavy milling cut, might chatter.

Belleville, N. J. J. E. FENNO

* * *

According to a recent issue of the *Economic Review of the Soviet Union*, there were, early in the year, over 3500 specialists engaged in the Soviet industries. Of these, about one-half were engineers and the remainder skilled workmen. More than 2000 of these men were Germans and about 750 Americans.

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

Piercing a Brass Shell from the Inside

S. B.—The lock housing shell shown in Fig. 1 is made of 18-gage half-hard brass. Obviously, it is unsatisfactory to pierce the two diametrically opposite slots from the outside. Can some reader of MACHINERY describe the design of a practical die or tool by means of which the slots can be pierced in this piece from the inside?

Answered by H. R. Hageman, Ontario, Calif.

For piercing the slots in a lock housing shell, such as shown in Fig. 1, the writer would suggest a press tool designed as shown in Fig. 3. This die or tool is arranged to have the punch pass through the shell from the inside. The reference letters used is this illustration indicate the same parts in both the upper and lower views. The punch *P* is of the double-end slotting type, and is stationary on the die-shoe. The two punch ends are of such length that the shell may be easily slipped over them.

The dies *A* on opposite sides of the shell are alternately forced over the opposite ends of the punch by the action of the two cams *L* and *M*, cam *M* having a pivoted cam member *N* which operates the die-holder *H* on the downward stroke. The die *A* is secured in the holder *H* by bolts *Z*, and is made in two parts to permit sharpening, the round opening in the die being ground to a slip fit over the outside of the shell. The position of the cam-contacting surfaces of the sliding die-holder *H* in relation to the cams when the punch has passed through the left-hand side of the shell is indicated by the dot-and-dash lines at *B*. The position of this section when the punch has passed through the right-hand side of the shell is shown at *C*.

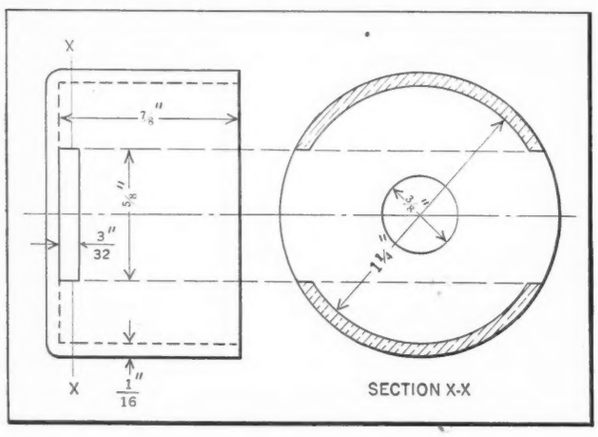


Fig. 1. Shell with Two Slots that Must be Pierced from the Inside

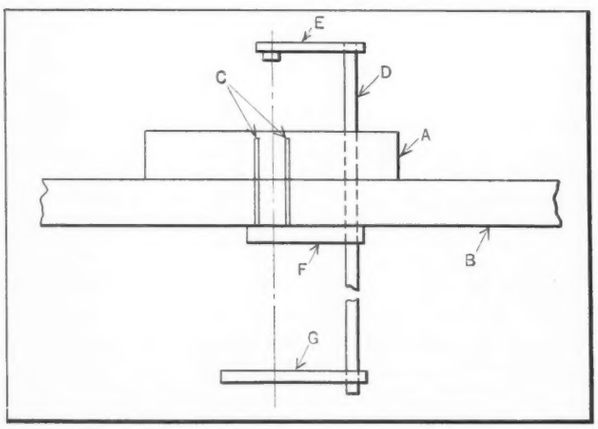


Fig. 2. Work-clamping and Ejecting Device

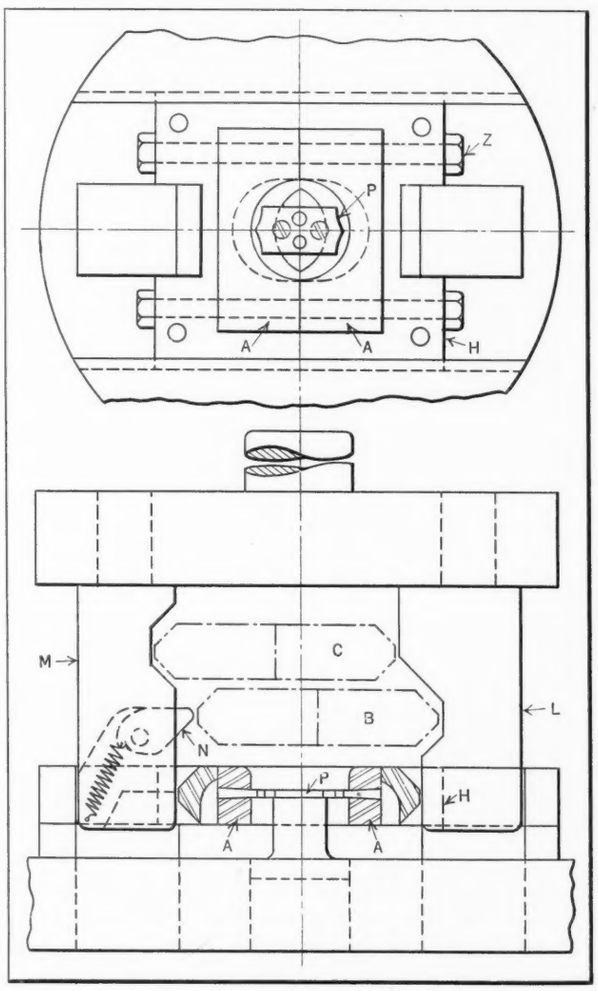


Fig. 3. Die for Piercing Slots in Shell Shown in Fig. 1

To complete this tool, it is necessary to provide means for holding the shell down so that it rests on top of the punch *P* during the piercing operation. Means must also be provided for lifting the shell out of the die after it has been pierced. These requirements are met by the device shown diagrammatically in Fig. 2. In this illustration, *A* is the die-block and *B* the die-bed.

Three or four pins *C* are a slip fit in corresponding holes in the die-bed, and are so spaced as to work just inside the opening in the die when it is in the loading position. The flat bar *D* works freely in openings in the die and die-bed, and is normally held in the upper position by means of springs, not shown. The members *E*, *F*, and *G* are rigidly fastened to the vertical bar *D*. The pressure arm *E* may be faced with a hard fiber block at the point of contact with the shaft. At *F* is the pad which raises the lift pins, and at *G* is the pedal by which the whole arrangement is operated.

Using Liquid Air for Expansion Fits

R. L. B.—Will someone who has used liquid air for shrinking a turned metal part so that it will give a tight expansion fit in the bore of a mating part kindly answer the following questions regarding the application of liquid air for this purpose?

1. Is the equipment for using liquid air for expansion fits expensive?
2. Is any difficulty experienced in keeping liquid air for a long time?
3. What is the average cost of liquid air and of the containers?
4. What is the effect of liquid air on cast iron?

A.—1. No special equipment is required other than the container for conveying the liquid air to the plant where it is to be used and the container in which the liquid is used for cooling the parts. It is recommended that the work container be made in the form of a square wooden box, carefully fitted and secured with brass wood-screws. Balsa wood is excellent because of its low heat conductivity, but soft white pine will do very well. Liquid air is quite penetrating, and unless the box is carefully fitted it is advisable to fill it up with water and let it stand for a few minutes until the wood fibers become soaked. The moisture in the wood will then become frozen and effectively seal the small cracks when the liquid air comes into contact with the walls of the box.

2. Metal containers of the vacuum type, containing activated charcoal in the vacuum space, hold the liquid with fair efficiency. The loss from evaporation with the five-liter container will range from 4 to 8 per cent in twenty-four hours. (One liter equals 1.06 U. S. quart.)

3. Liquid air is sold by oxygen plants in small quantities at about $1.25 per liter. In large quantities the price may be as low as 50 cents per liter. A five-liter liquid air container of the type referred to costs from $60 to $75.

4. So far as we know, there is no permanent effect on commercial metals when subjected to the low temperature produced by liquid air. However, there may be exceptions of which we are not aware, but, in general, the process can be used for all common ferrous and non-ferrous metals and alloys.

Permanent Molds for Zinc-Alloy Castings

W. H. B.—Referring to the article "Permanent Molds for Zinc-Alloy Castings," in July MACHINERY, page 829, the writer would like additional information on the following questions:

1. Is a commercially prepared alloy used for this type of casting and if so, under what trade name is it sold?
2. Is any kind of lubricant used on the molds?
3. Can the molds be made from either cast iron or machine steel?

Answered by W. W. Broughton, Technical Service
The New Jersey Zinc Sales Co., New York City

The article in July MACHINERY indicates that there are many possible applications of this method of fabrication yet untried. At present, the process is confined primarily to the lighting fixture and novelty industries, but its economy and flexibility should attract the attention of engineers in other industries. The questions submitted in the foregoing will be answered in numerical order.

1. "Horse Head" zinc can be readily cast in molds. The physical strength of castings of unalloyed zinc, however, is decidedly limited, and alloys are available having this metal as a base that possess far superior strength, hardness, and ductility. The most satisfactory mixture from the standpoint of both ease of casting and physical properties lies within the following limits: 4.25 to 4.75 per cent aluminum; 0.5 to 0.8 per cent copper; and the balance Horse Head Special slab zinc. This mixture can be obtained by specification from almost any metal jobber. An alloy that is very satisfactory for most uses can be made directly in the melting pot or crucible by adding one or two per cent aluminum to the well-known "4-3-0.05" die-casting alloy sold under the trade name of "Zamak No. 2."

2. Molds are often smoked with coal-oil soot or painted with shoe blackening to avoid sticking.

3. Molds can be made of either cast iron or machine steel, but are frequently of sand-cast bronze, and may be much less complicated than the ones illustrated in July MACHINERY. The castings can be removed by tapping the mold with a rawhide hammer while holding it above the bench by pliers or by wooden handled bolts.

* * *

Don't overlook the perils of obsolete equipment. It is wiser to have the junk heap outside the factory than inside.—*Julius H. Klein, Assistant Secretary of Commerce.*

A Free-Wheeling Screw Press

One of the Latest Features Incorporated in Automobile Design is Not New in Press Construction

By FRED R. DANIELS

FREE-WHEELING is a comparatively new term in automotive parlance, although the mechanics of free-wheeling are not new. The basic feature of the principle is the roll friction clutch shown in Fig. 2. In automobile design, this type of clutch is introduced in the transmission to connect and disconnect the engine and the drive shaft automatically. Thus, the engine drives through the clutch and the car gathers momentum which, on a downward grade or a level surface, may cause its speed to increase and exceed that of the engine; or the engine may be retarded, permitting the car to roll along under its own momentum. In either case, the greater velocity of the drive shaft causes the clutch to disengage until such time as the engine is speeded up, or the car speed diminished to the point where the two speeds become equal. When that occurs, the clutch re-engages and the engine again drives the car.

Obviously, there are instances where this ability to disconnect the drive automatically can be used to advantage in press work. In fact, it is the adaptation of this principle to a screw press of conventional type, and the advantages derived therefrom, that constitutes the substance of this article.

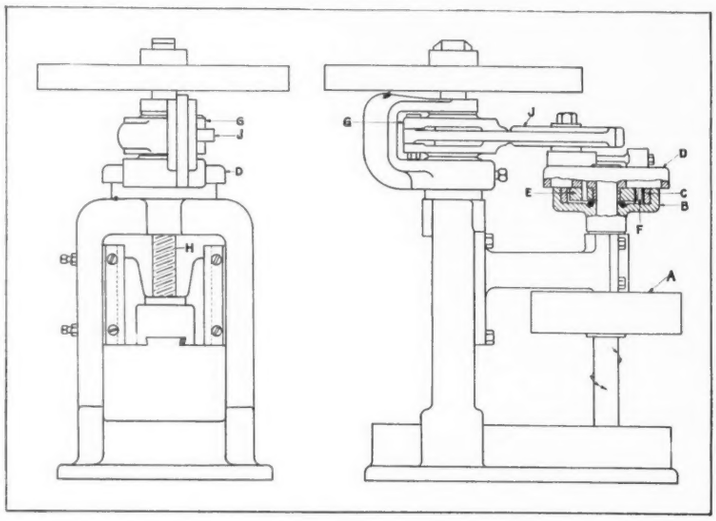


Fig. 1. The Quality of the Product of the Standard Screw Press is Improved by Applying Free-wheeling Power Transmission

The gate or slide of a screw press is usually operated by a heavy handwheel which is used to turn a large screw from which the gate is hung. The pitch of this screw is great enough to enable the gate to be moved without much physical effort, yet it is a tiring task when performed continuously, and the element of physical fatigue often affects the quality of the work. However, by applying a mechanical drive to actuate the screw, a uniformity of product can be obtained that could not be secured by the hand operator, with his varying strength and activity.

This result could be accomplished with an ordinary crank motion drive if the press work consisted only of cutting the metal. However, for swaging and forming operations, the regular crank motion will not produce the uniform pressures required, unless the metal is of the same thickness throughout. The fact that strip metal does vary slightly in thickness introduces varying crank pressures on work of this kind; for example, if the metal is thicker than normal in spots, the pressure will be greater, and that is where free-wheeling functions to advantage.

A roll friction clutch introduced in the crank motion drive permits the energy stored in the handwheel (which functions as a flywheel) to advance the speed of the screw so as to disconnect the clutch and carry the gate down independently of the power drive. Since this occurs during that part of the stroke in which the work is performed, the pressure delivered is always the same, regardless of variations in metal thickness, because it is the result of a blow of uniform force and is not influenced by the stretch of the frame.

In the jewelry, optical, and novelty trades, particularly, there is considerable use for a screw press that will exert a uniform blow. Two views of such a press, one a front elevation and the other a side elevation, with the clutch partially in section, are shown in Fig. 1. The drive shaft is mounted vertically at the rear, and is driven, through belt to pulley *A*, in the direction indicated by the arrow. The roll friction clutch housing *B* is keyed to this shaft and rotates with it at constant velocity.

Fig. 2 shows a sectional plan view of the clutch in which similar parts are designated by the same reference letters as are used in Fig. 1. The housing *B* is lined with a hardened friction ring *C*. The crank-plate *D* (see Fig. 3) is free to rotate on the upper end of the drive shaft, and a friction disk *E*, Fig. 2, is doweled to it, which is capable of being rotated independently of and within housing *B*. Between ring *C* and disk *E*, pocketed in notches cut

in the periphery of the disk, there is a series of hardened gripping rolls *F* which, by frictional engagement, connect the driven housing *B* with the floating crank-plate *D*.

The crank-plate (Figs. 1 and 3) and clamp arm *G*, which is adjustably attached to the operating screw *H*, are joined by a special spring compensator connection *J*, so that when the clutch is in engagement, the screw is driven through the clutch from the drive shaft.

The operation of the press is as follows: With the gate down, the crank-plate, connection, and clamp arm are in the position shown in Fig. 3. The clutch housing *B* (Figs. 1 and 2) is driven continuously in a counter-clockwise direction and at a constant speed, which causes rolls *F* to engage ring *C* and disk *E*. This, in turn, causes the crank-plate and screw to revolve and the gate to be raised to its uppermost position, at which point the crank-plate has rotated 180 degrees, so that crankpin *K* is at point *L* and the connection *J* is in the position shown partially in broken outline in Fig. 3.

The continued rotation of crank-plate *D* swings clamp-arm *G* in the opposite direction, reversing the direction of rotation of the screw and starting the gate downward. The heavy fly-wheel gathers momentum as the gate descends until, at about the point *M*, the speed of the screw, and consequently of disk *E* (Figs. 1 and 2), exceeds that of the drive shaft, causing the frictional contact of rolls *F* to be released. In other words, this acceleration in screw speed automatically releases the clutch and a complete revolution of the screw is obtained in less than 360 degrees of crank motion. The tools strike the work with a hammer-like blow, and the steep helix angle of the screw threads permits the gate to rebound under the force of the blow, momentarily stopping and reversing the rotation of the screw. This permits the constantly rotating clutch housing to overtake disk *E* and re-engage the clutch, which action takes place near the end of every complete revolution of the drive shaft. The cycle of movements is then started over again as the gate begins to ascend.

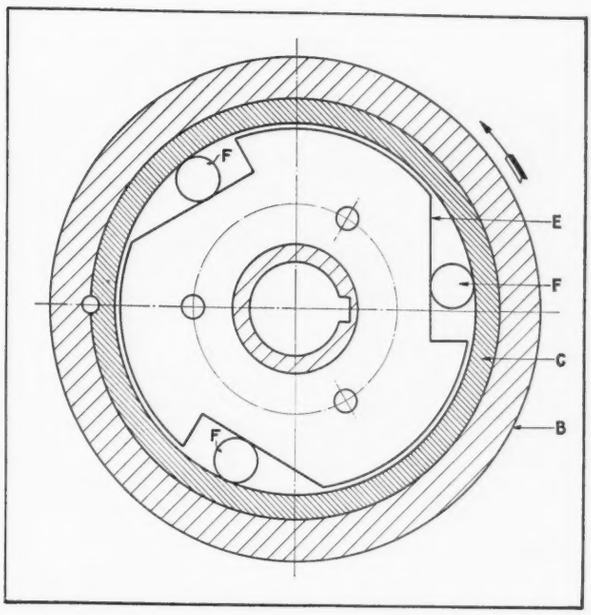


Fig. 2. Sectional Plan View Showing Principles of Construction of the Roll Friction Clutch, or Free-wheeling Unit

This practical application of a mechanical device which has only recently been introduced in automobile design was patented and applied to a screw press more than eleven years ago by the Waterbury Farrel Foundry & Machine Co., of Waterbury, Conn. The patent was obtained under the name "stamping press for constant blow."

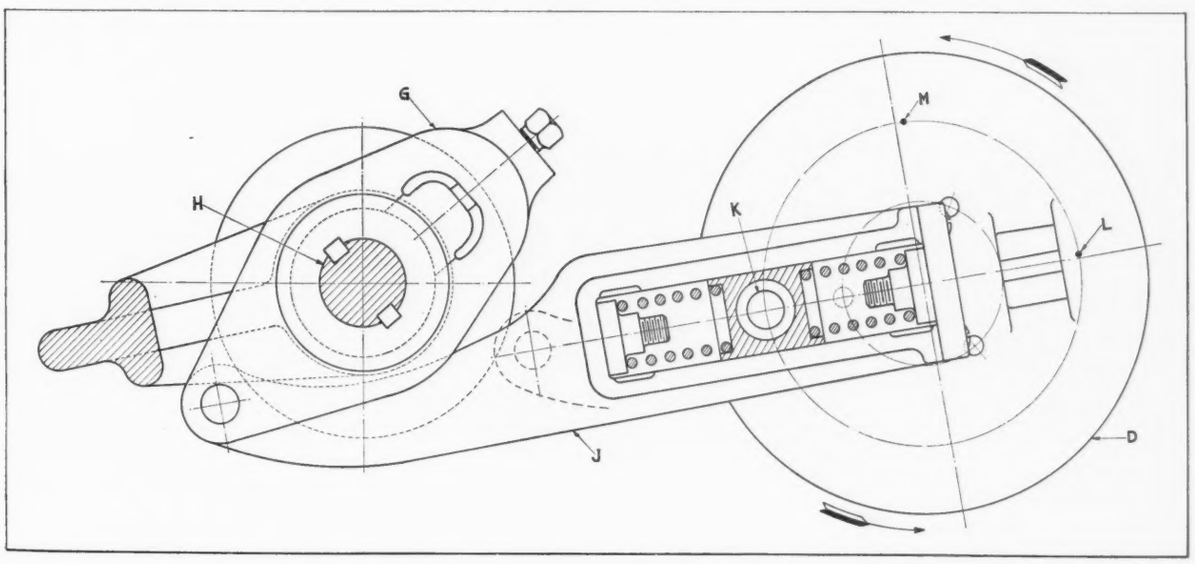


Fig. 3. Plan View, Illustrating the Crank Connection and the Action of the Screw when Driven through a Roll Friction Clutch

How Polishing Abrasives Have Been Improved

Polishing Wheels have been Given Maximum Efficiency and Life by the Scientific and Accurate Control of the Methods of Manufacture, Testing, Grading and Applying the Abrasive

By HENRY R. POWER, Carborundum Co.
Niagara Falls, N. Y.

TO obtain maximum service from a polishing wheel "set up" with an aluminum oxide abrasive, it is necessary that the abrasive have certain properties. These properties are secured by employing carefully controlled laboratory methods from the moment the bauxite ore is mined until the finished abrasive is placed in its container ready for the market. This includes accurate control over the electric furnace, the correct proportioning of the mixture of coke and ore, and the application of chemical and physical tests at every step.

The success attained by such control is demonstrated by the various types of fused aluminum oxide that are now available for different applications in the abrasive field. A product of large, medium, or very small crystal structure may be obtained at will. Recently aluminum oxide has been produced in the electric furnace having practically the same physical characteristics as natural rubies and sapphires, except for transparency.

Improved Grading or Grain-Sorting Methods

An important characteristic of the finished loose abrasives is the sizing or separation of the particles into groups of approximately the same size. The abrasive manufacturers have installed modern grading equipment to make this separation as exact as possible, so that there will be no coarse grit in any grade to cause scratching in the polishing operations, and the maximum amount of nominal or true grit size that is commercially obtainable will be secured.

In the interests of standardization, a body known as the Technical Committee of the Producers of the Electric Furnace Abrasives has been formed. This committee includes every producer who has drawn up specifications for testing methods and tolerances based on the U. S. standard screens. Thus the same grain sizes are now available from every producer. These standards have been adopted as a simplification program by the Department of Commerce.

In view of the heterogeneity of abrasive particles, the adoption of these specifications, which give the consumer alternative sources of supply as regards size, is a distinct step forward and assures uniformity of all shipments. Moreover, the test method worked out by the Technical Committee gives the consumer an opportunity to check his purchases.

Increasing the Surface Tenacity or Adhesive Quality in Abrasive Grains

The graded abrasives are now treated by chemical and physical methods to improve their adhesion to glue—the binding agent used on polishing wheels. This property is known as "surface tenacity," and differs from the "internal tenacity" produced by the electric furnace in the preliminary manufacture from the bauxite ore. The internal tenacity of modern abrasives was developed to such a degree that special attention had to be given to the problem of holding the abrasive in place until completely worn out. Surface tenacity was developed for this purpose and is the logical step in the interests of efficiency. Abrasives made with a high surface tenacity have a gray appearance.

The aim of the polisher is to get the longest life possible from a polishing wheel before it has to be recoated with an abrasive. It has also been noted that polishing wheels coated with abrasives having a high surface tenacity wear down without the formation of large depressions, such as formerly made it necessary to recoat them frequently. Formerly abrasives were shiny and "slipped" badly in the trough when setting up or coating the polishing wheels.

Abrasives treated for surface tenacity are rough and "pack" well. They conform to the periphery of the cloth wheel when the latter is rolled in the trough of abrasive. Thinner glue has actually been used in some cases, because of the great adhesion of the dried glue and abrasive. Moreover, the abrasive applied to the wheel periphery is of the open coat type, which gives clearance, prevents the wheel from being filled up, and grinds fast continuously.

Testing Adhesion of Glue

The greater adhesion of glue to the type of abrasive considered here can be demonstrated by making briquettes of the glue and abrasive, and curing them for several weeks. These briquettes are then pulled apart in a tensile strength testing machine such as is used for testing cement. A force of more than 1200 pounds per square inch is required to break briquettes made with abrasives having high surface tenacity, whereas the old type abrasives break under a force of 900 to 1000 pounds per square inch. This method of testing is regularly used in controlling the manufacture of the so-called "surface tenacity" abrasives.

Importance of Capillarity

In order that abrasives may be wet quickly with the glue solutions before chilling, abrasive particles must possess the property known as capillarity. Capillarity can best be described by outlining the method of testing abrasives for this property. Dry abrasive grains are placed in a dry glass tube which is open at both ends and which has one end standing in water. The water rises to a definite height if the abrasive possesses "capillarity," but will not rise with abrasives difficult to wet, such as those containing oil or grease on their surfaces.

Capillarity is important in the abrasive field, for if this property is absent, the glue solution does not have a chance to envelop each granule. Without this setting in the glue, the abrasive may fall out of place in the "green wheel."

Testing for Density

Abrasives produced in the electric furnace are naturally more or less splintery and flaky, and a finishing operation consists in removing such particles, which are recognized as inefficient and which simply take up room on a polishing wheel. This removal increases the apparent density of the abrasive, so another test method was devised to control this operation. With this test, the abrasive is jolted a definite number of times, and the volume per unit weight is compared with a standard for a particular size under test. The application of this test is still another step forward in the development of a perfect polishing abrasive, which has already reached a very high degree of uniformity and efficiency.

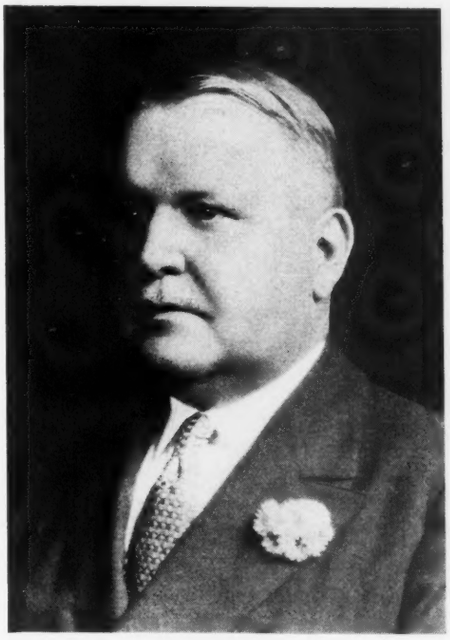
* * *

An interesting departure in the matter of working hours has been made by the Kellogg Co., Battle Creek, Mich. This company operates its plant continuously, owing to the nature of the processes employed. In the past, the plant operated on three eight-hour shifts, but now four six-hour shifts are used. In making this change, the minimum wage of $4 per day for male employes was retained. Wages above the minimum rate were readjusted so that, while the hourly earnings became greater, the total earnings in dollars and cents would not necessarily be the same as for an eight-hour day, being based upon the purchasing power of the full day's wages in 1928.

Conrad Lauer New President of the A. S. M. E.

Conrad N. Lauer, president of the Philadelphia Gas Works, has been elected president of the American Society of Mechanical Engineers for the year 1932. Mr. Lauer was born in 1869 in Montgomery County, Pa. From 1893 to 1902 he was connected with the Link-Belt Co., serving in various capacities ranging from time clerk to acting superintendent of the plant. He also assisted in introducing scientific management methods in that company's shops.

In 1903 he became associated with Dodge & Day, engineers, continuing with their successors, Day & Zimmermann, Inc. During this period he dealt with a variety of engineering problems incident to the selection of equipment for industrial plants, lay-out of plants, routing of materials, and determination of types of building structures best suited for different industrial purposes. During the war he was in charge of large construction projects under government contracts. During the later years of his connection with the Day & Zimmermann organization he was vice-president and director of the company.



Conrad Lauer, Newly Elected President of the American Society of Mechanical Engineers

Mr. Lauer has received the honorary degree of mechanical engineer from Stevens Institute of Technology. He is the author of "Engineering in American Industry," and a contributor to the technical press.

Mr. Lauer has a long record of valuable service with the American Society of Mechanical Engineers. In 1919 he was chairman of the Philadelphia Local Section. He was a member of the Committee on Meetings and Program of the Society from 1922 to 1926, serving as its chairman in 1926. Later he was elected one of the managers of the Society, and has for several years been a member of the Executive Committee of the Council. At present he holds the office of vice-president of the Society.

* * *

According to figures compiled by the United Air Lines, the average airplane ride at the present time is 244 miles, contrasted with 153 miles a year ago. The average airplane fare is now approximately $17, or 7 cents a mile. Three years ago the average flight was approximately 30 miles, much of it being short sightseeing tours.

The Shop Executive and His Problems

Superintendents and Foremen are Invited to Exchange Ideas on Problems of Shop Management and Employe Relations

TO the reasons given on page 937 of August MACHINERY against the practice of using homemade repair parts, I would like to add the following: In making a repair part like the original, the ability of the shop man to differentiate between alloy and carbon steel, and between hard and soft brass, for example, is not sufficient. The part may depend entirely for its successful functioning on some heat-treatment or some alloying constituent. While the latter could be identified in the laboratory, this is impracticable, because it would increase both time and cost.

Again, while it is easy for the shop man to measure a part for dimensions, manufacturing tolerances cannot be determined from a single unit. The proper fit is important, and is likely to be imperfect on a homemade part. Any designer could multiply the objections to homemade parts. Briefly, however, the making of homemade repair parts is generally an unsatisfactory practice which should only be resorted to in an emergency.

EARL L. FAIRALL

Should Foremen be Selected for Their Skill?

Referring to the article on page 908, in August MACHINERY, the writer believes that when 627 foremen state that their greatest difficulty is in the instruction of men, we realize more than ever before the importance of the foreman's ability to instruct. A highly intellectual man is seldom a good instructor. He has learned everything with practically no effort and has no difficulty in grasping anything. It is not easy for him to convey his knowledge to others, and he becomes irritated in trying to do so.

We are all familiar with the type of foreman who says, "Square this up, scribe a line across here, put a 3/8-inch tapped hole there and a 1/4-inch clearance hole here," and then rushes off leaving the man in a bewildered state of mind. The foreman knows why he wants these operations, but the workman does not know why. As a result, many mistakes are made and blamed on the workman.

The foreman who has gained his position, not because of brilliancy of mind but by sheer force of perseverance and concentration, has learned what he knows slowly and laboriously. He realizes the difficulties that the men he is instructing are having, and, step by step, in simple understandable terms, he endeavors to teach them. He not only tells them what to do, but why. If a man knows why he is doing certain things, it helps him greatly to do the work right.

However, a foreman may be an excellent instructor, and at the same time a poor executive and organizer. The foreman with a great deal of executive ability is seldom a highly skilled mechanic. I once knew a man who was a very poor mechanic and seldom made a really good job of anything. A few years later, I was surprised to find him holding quite an important executive position. I had a good opportunity to observe him in his new work, and I must say that his ability as a supervisor was quite remarkable.

As executive ability and teaching ability seldom go together, I would say that both types of men are needed at the head of a department. The executive would be in charge, but he should have an assistant that specializes in instructing. The two men should cooperate in their work, and the management should endeavor to encourage each to appreciate the importance of the other's abilities.

ALFRED LAYZELL

Reducing Costs Without Cutting Wages

In one plant that has been unusually successful in reducing costs without reducing wages, each one of the leading executives has a definite schedule of visits to departments laid out for him, covering the entire week. It is his duty to keep in close touch with all shop problems and to watch for chances to improve and speed up operations. Then, once a week, all the executives meet and bring up the points that have come to their attention during the week.

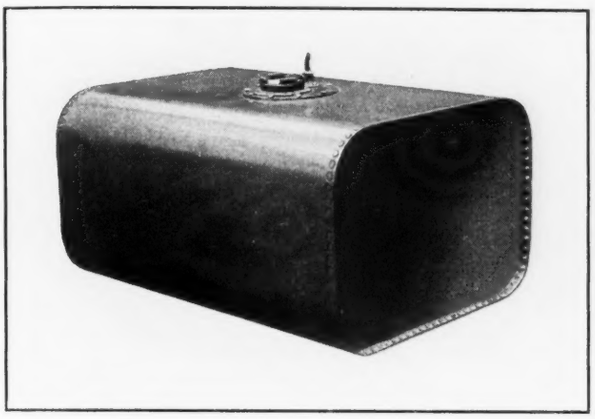
The improvements that have been put into effect as the result of this procedure have been quite remarkable. In addition, the efforts made by the higher executives have stimulated the foremen and others in minor executive positions to do everything possible to reduce costs and at the same time maintain wages. The results of this plan have been highly satisfactory. CHARLES R. WHITEHOUSE

[Specific information as to what has been done in other shops to accomplish similar results would be of considerable value to the industry. MACHINERY'S readers are invited to submit such information for publication.—EDITOR]

Points on Making Duralumin Tanks with Riveted Joints

By A. EYLES

Duralumin sheets used in the fabrication of tanks are generally heat-treated to increase their tensile strength. This increase in strength is obtained by heating, quenching, and aging. The heating may be done in a furnace or a salt bath.



Duralumin Tank with Countersunk Rivet Joints

The furnace can be heated by electricity, gas, or oil. Coal, coke, or charcoal should not be employed, owing to the formation of explosive mixtures. The best practice is to heat the sheets in a bath of equal parts of sodium nitrate and potassium nitrate.

In the fabrication of duralumin tanks or any members that are to be subjected to stresses, it is important that the joints be made with rivets, as experience has shown that welded fuel tanks of duralumin and aluminum frequently suffer from corrosion at or near the welds.

The rivets should be made of the same material as the sheets to be joined, and, as a rule, should be obtained in the annealed condition. In this condition they are generally sufficiently ductile to withstand heading satisfactorily. Occasionally, splitting or cracking of the heads of the larger sizes of duralumin rivets is observed, and in such cases, the rivets should be heat-treated and quenched immediately before use. They are then quite soft and ductile, since hardening occurs gradually and continues for four or five days. If used before they have had time to age, they will harden in position.

The thickness of duralumin sheets used in fabricated members for aircraft and automobiles rarely exceeds No. 12 gage (0.104 inch). For sheet duralumin up to this thickness, the rivet diameter may be taken as $d = t + 0.08$ inch, in which d = rivet diameter, and t, thickness of sheet, in inches.

In tank construction, where the joint must be leakproof, the rivet diameter must be larger, and the pitch or spacing reduced to the smallest amount possible. Large-headed rivets should also be used to obtain maximum bearing surface. Having determined the rivet diameter and pitch, the requisite strength is obtained by using a sufficient number of rows of rivets. This calculation requires a knowledge of the shearing and tearing strength of the material. For duralumin in the hard or medium hard temper, the ratio of shearing strength to tearing strength can be taken as 0.7 to 0.8.

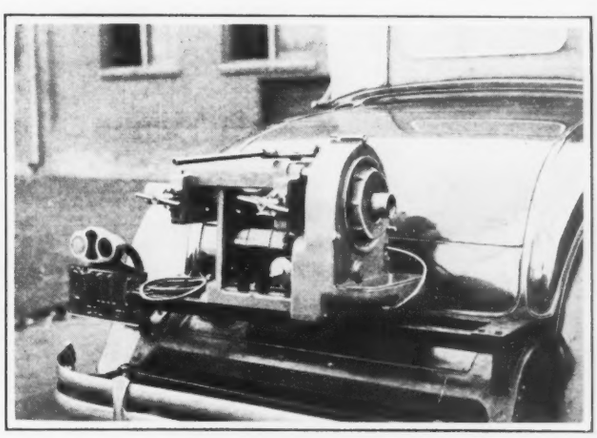
In the accompanying illustration is shown a gasoline tank fabricated from No. 20 gage (0.036 inch) duralumin. The joints are made with a single row of De Bergue patent rivets. This process of riveting was described in May MACHINERY, page 692. The rivets used in the tank illustrated are 5/32 inch in diameter and are spaced 5/8 inch between centers. With ordinary riveting, it is common practice to use as many as three or four rows of rivets in a seam or joint so as to obtain a joint that will hold gasoline. Soft aluminum foil is sometimes used between the sheets to insure tightness of the joint. Even when this is done, the strains to which the tank is subjected in service may cause leakage. With the countersunk riveting used on the tank shown, the sheets are interlocked at each rivet and are well adapted to resist strains.

The tank illustrated was subjected to the usual official test for aircraft tanks. In this test, the seams and joints are coated externally with whiting and allowed to dry. The tank is then partly filled with kerosene and subjected to air pressure. The tank withstood this test without the slightest trace of dampness showing on the whiting.

* * *

Demonstrating a Portable Threader from Coast to Coast

When the Axelson Mfg. Co., Ltd., Los Angeles, Calif., brought out the improved model portable threader here illustrated, it was decided to demonstrate one of these machines to jobbers and users all over the country. For this nation-wide tour, the threader was mounted on the back of an automobile roadster. The equipment has a capacity for cutting, reaming, and threading pipe from 1/2 to 2 inches. Bolt threading dies can also be applied.



Portable Threader on Rear of Automobile for Nation-wide Demonstration

Laying Out and Boring Accurately Spaced Holes

By W. C. BETZ, Master Mechanic, Fafnir Bearing Co., New Britain, Conn.

THE procedure described here for laying out and boring holes to suit accurately dimensioned lay-outs is simple, accurate, and speedy, as compared with the button method and most other methods now in use. The equipment required includes an accurate set of size blocks, a special lay-out plate *A*, Fig. 1, and a master block *B*. With this equipment, extremely accurate center distances may be laid out and punched or drilled by employing the size blocks *C* as shown.

The plate *A* is of cast iron with parallel T-slots spaced about 2 inches apart and cut at an angle of 45 degrees to the center line of the plate. After plate *A* has been machined and scraped to a true surface, the square *D* is secured to it by dowels and screws. The stud *E*, with the screw *F* and swiveling clamp *G* that holds the master block *B* against the size blocks *C*, is slid into one of the T-slots in plate *A*. The screw *F* is drilled to receive the shank of the swivel clamp, which is backed up by a compression spring *S*.

The master block *B* is made square, with the sides equal to the face length of the size blocks and with the height *J*, Fig. 2, equal to their width. The hole in this block is lapped straight and to size within accurate limits, and the four edges of the block are so ground that the hole is exactly central and at 90 degrees with the base. The center-punches *H* are ground by gripping one end in a chuck and grinding the shank and center at one setting. The ground punch is then gripped by the chuck while the other punch is finished in a like manner. These punches are next lapped to a push fit in the master block *B*, and are then broken apart and rounded on the ends opposite the center-punches, as indicated in the illustration.

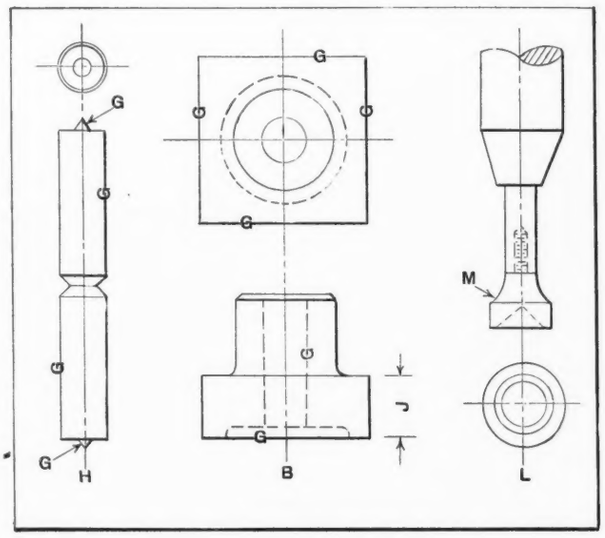


Fig. 2. Parts Used with Equipment Shown in Fig. 1

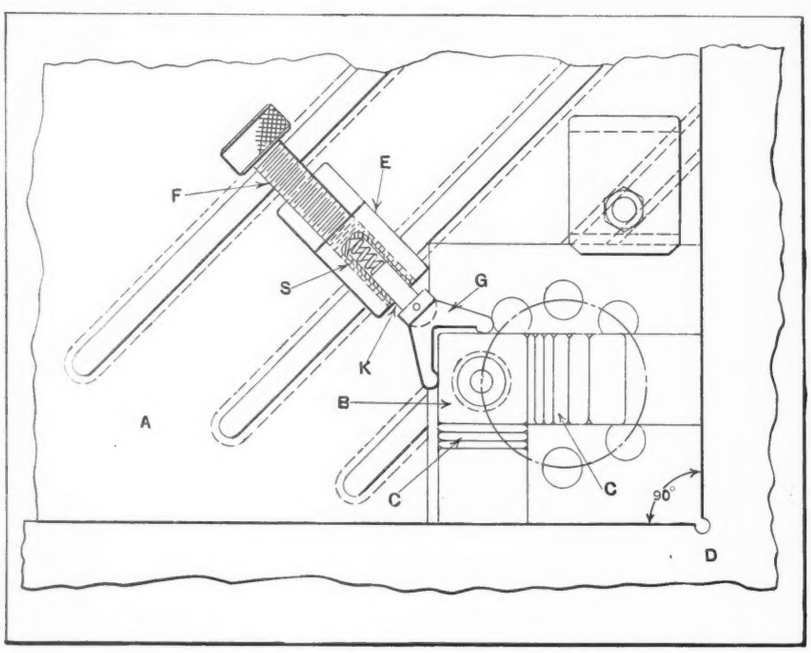


Fig. 1. Special Equipment Used with Size Blocks for Locating Holes

To use this lay-out equipment, the work is located and clamped to the plate *A*, Fig. 1, in the corner next to the square *D*, but it need not touch the sides of the square unless the centers are to be accurately laid out from the edges of the work, in which case the two edges of the work from which the centers are to be laid out must be ground to form an angle of exactly 90 degrees. These ground edges are located snugly against the sides of the square *D*. All centers are then laid out from the two sides of the square.

The tension against the blocks and the sides of the square is always the same, due to the swiveling clamp and the spring pressure exerted on the end of the clamp shank. The equalization of this pressure is accomplished by adjusting the screw *F* so that the gap at *K* is a predetermined width

as measured with a feeler gage. As each center is laid out or located with the size blocks and master block, a punch mark or center is made with the aid of an automatic center-punch *L*, Fig. 2, which is fitted with a special cap or anvil *M*. This punch insures a uniform depth for all centers. After all the centers have been spotted, the work is mounted on an accurately trued faceplate of a lathe and each spot is trued up with the lathe spindle by means of a "wiggler" or a rod center and indicator applied in the usual manner. The holes thus located are drilled and bored to size.

By this system, the chance of error due to the human element is greatly lessened, because, first, the center distances are established by placing together the size blocks necessary to give the required dimensions; second, the pressure on the sides of the square is controlled by accurately gaged spring tension; and third, mistakes in making hand measurements with micrometers and verniers are eliminated, and errors that might creep in as a result of adjusting or moving the buttons or work are also avoided.

It sometimes happens that small holes must be spaced accurately and very close together. Work of this kind can easily be handled by placing a drill bushing in the hole in the master block and putting the plate directly on the drill press table for spotting the holes with a drill. It is not necessary to drill the holes completely through the work. They need be spotted only deep enough to insure having the drill run true, say to a depth equal to about the diameter of the drill. The drilling can then be finished by placing the work on the faceplate of a bench lathe or on the table of a sensitive drill press, provided the alignment of the table and spindle has been checked for accuracy. If the table is not exactly at 90 degrees with the spindle, an auxiliary plate may be employed which can be trued up by the use of paper shims.

* * *

Growing Interest in Plant Visits

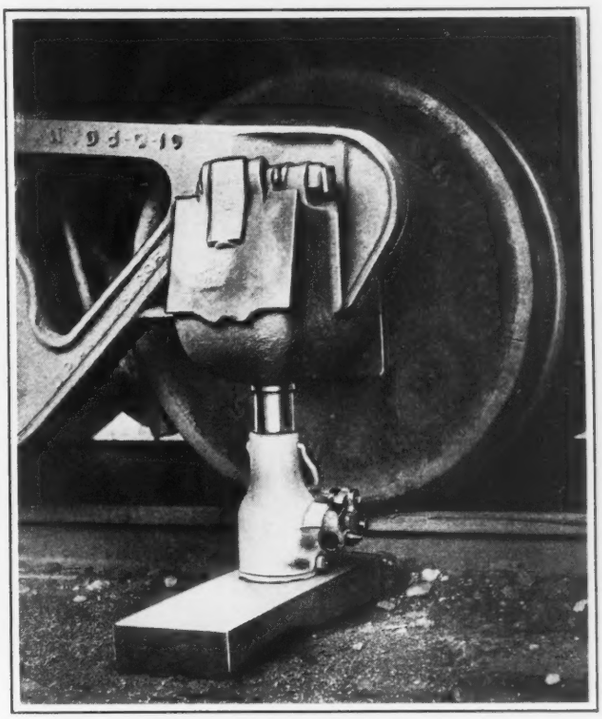
A great deal of interest has been shown recently in group plant visits by foremen's clubs. On September 11, the Dayton Foremen's Club of Dayton, Ohio, visited and inspected the plants of the Cincinnati Milling Machine Co. and the Cincinnati Grinders, Inc., more than 550 men passing through the plants. On September 15, 120 members of the Cincinnati Foremen's Club inspected the shops and the machine tool laboratory of these companies, the latter containing twenty-four milling and grinding machines, all under power and in operation. On September 19, 150 members of the Springfield, Ohio, Foremen's Club visited Cincinnati for the inspection of the same plants.

The interest shown by these foremen's clubs is an indication of the value to foremen of plant visits. Such visits will inform them of the latest production methods and keep them in touch with recently designed shop equipment. More and more firms are encouraging such visits.

A 26-Pound Jack that Lifts 25 Tons

The light-weight car inspectors' journal jack shown in the accompanying illustration is adapted for industrial, construction, and general railroad work. It is made in two sizes, one size having a capacity of 15 tons, and the other a capacity of 25 tons. Both sizes are equipped with a positive-stop safety feature that prevents the lifting standards from becoming disengaged.

The 25-ton jack weighs only 26 pounds, or approximately one pound per ton of capacity, and the smaller size jack weighs 19 pounds. This remarkably light weight is made possible through the use of a heat-treated aluminum alloy sand-casting for the housing. The aluminum alloy shell resists the corrosive action of the sulphur-laden atmosphere of roundhouses, train sheds, and other structures in which coal gas is present.

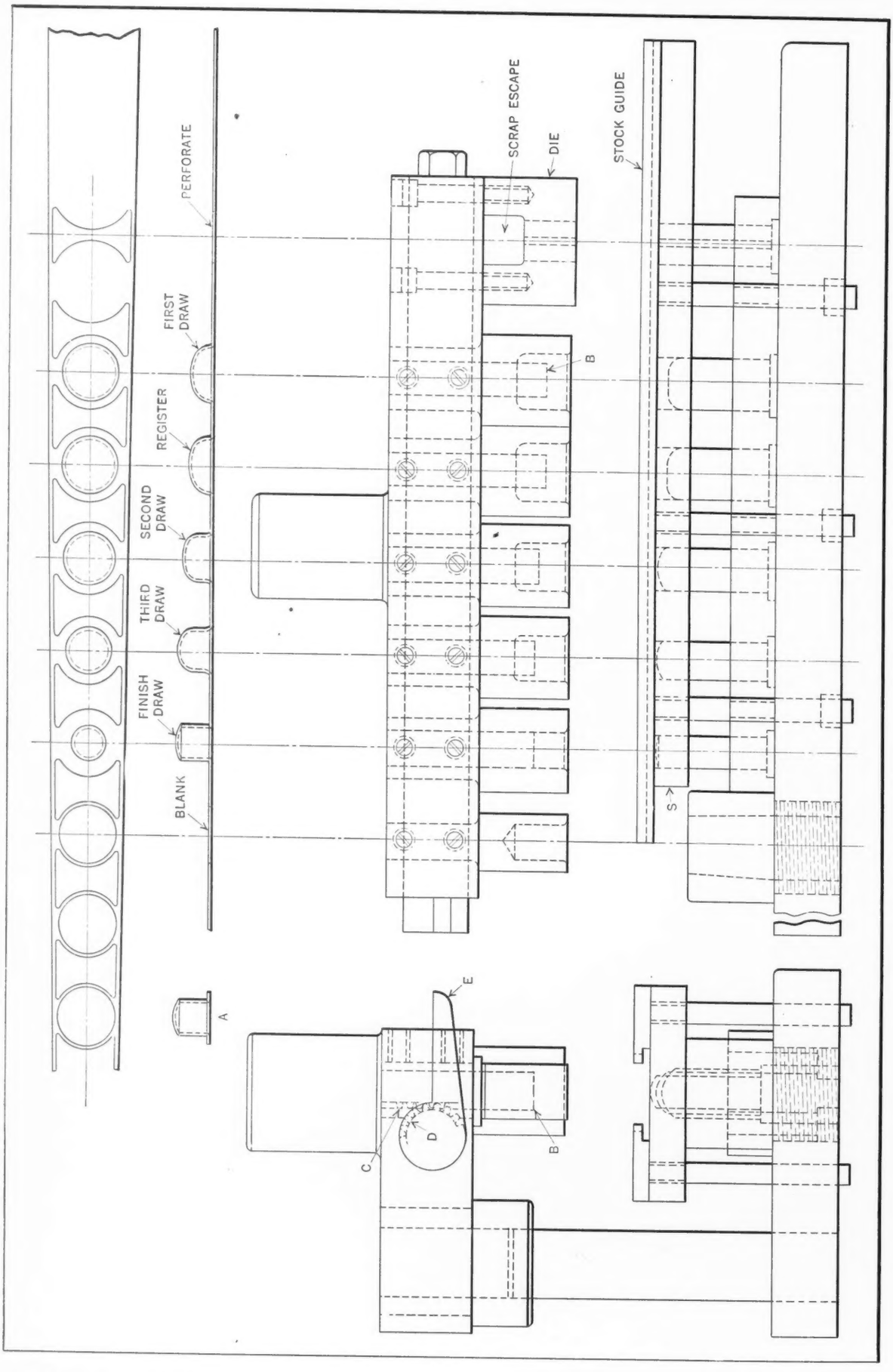


Light-weight Jack for Inspecting Car Journals—
It Lifts a Ton for Each Pound of its Weight

Since the steel mechanism within the shell is packed with grease, the jack is practically impervious to all weather conditions. These light-weight jacks, which are made by Duff-Norton Mfg. Co., Pittsburgh, Pa., have been thoroughly tried out and found to have a safety factor of at least 25 per cent over their rated capacities.

* * *

According to the *Compressed Air Magazine*, high-speed steel wood-planer knives, plated with chromium, have proved, by tests on kiln-dried lumber, to have 25 per cent longer life than regular wood-planer knives.



Seven-station Follow-die Provided with Positive Knock-outs Actuated by a Pinion Shaft

Roll-Feed Follow-Die with Positive Knock-Out

By F. C. MASON

In the accompanying illustration, is shown a follow-die for producing the flanged shell *A* from steel 0.035 inch thick. This shell is 9/16 inch in diameter by 9/16 inch deep, and has a flange 7/8 inch in diameter. All the important parts of the die are shown in the two lower views, while the work done at each station is shown directly above by the plan and end views of a strip of the stock. The stripper *S* should be operated by an air cylinder, although it is possible to obtain fair results with the usual coil spring or rubber cushion. The stripper also functions as a draw-plate, and the uniform pressure provided by an air cylinder is therefore desirable.

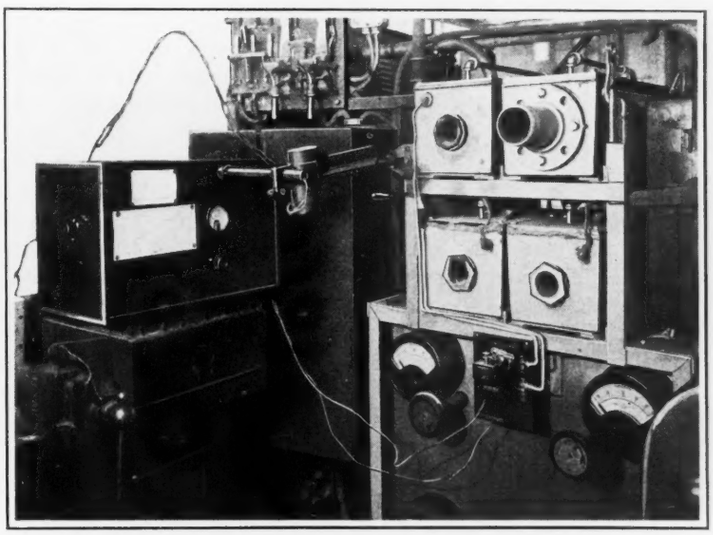
All the drawing dies are located in the upper member, and are provided with positive mechanical knock-outs. This is a necessary feature in a die of this kind. The knock-outs have rack teeth at one side, as shown at *C*, which mesh with pinions *D* on a shaft which extends the full length of the upper holder. The knock-out lever *E* at one end of this shaft is actuated by a trip pawl (not shown), which is fastened to the lower part of the die. The lever *E* slips past this trip on the downward stroke, but acts at once at the beginning of the upward stroke. The lever is automatically released at a point in the upward stroke where the work is clear of the dies.

The first two drawing stations of a die of this type must be alike, in order to obtain satisfactory results. The second of these stations acts as a spacing register, and from that point on, the spacing will be uniform. If this feature is not incorporated in the die, the stock will creep and the punches will cut out of bounds. When properly constructed, a die of this type can be run on coil stock at the highest rates of speed ordinarily available.

Keeping an "Eye" on the Furnace

The electric eye, or photo-electric tube, now turns to the special high-temperature furnace to see that it does not get too hot; when the temperature rises to the desired limit, it operates a thyratron tube which cuts off the current or fuel supply. Thus another addition is made to the list of uses for both the thyratron and the photo-electric tubes. In the past it has been difficult to read the high temperatures required in special furnaces used for industrial and laboratory purposes, and it has been exceedingly difficult to control these furnaces properly or maintain a predetermined temperature.

At the recent meeting of the American Chemical Society in Buffalo, Dr. L. R. Koller, of the General Electric Research Laboratory at Schenectady, announced a solution for the problem in using the photo-electric tube to measure the visible energy radiated by the hot body, and hence its temperature. The photo-electric tube, with a suitable optical system, "looks" at the furnace wall or some object in the furnace. The current through the tube depends on the amount of light falling upon it, and accordingly varies with the brightness of the surface observed. Since the radiation from a hot body varies much faster than its temperature, the photo current is a very sensitive measure of temperature.



Controlling Furnace Temperatures with Photo-electric and Thyratron Tubes

* * *

The organization "Guipromach," 21 Miasnitzkaia, Moscow, Russia, representing the State Planning Institute of the Soviet Republics, which organization is instrumental in the designing of all new plants and the reconstruction of present manufacturing facilities in the machine-building and metal-working industries, wishes to be placed in touch with all new developments in these branches of industry. The organization would like to obtain, from American manufacturers, catalogues pertaining to new products.

Nickel Cast Iron for Pistons and Cylinders

The following information on the use of nickel cast iron for automotive engine parts was given in a paper read before a meeting of the Society of Automotive Engineers by Thomas H. Wickenden, International Nickel Co., Inc., New York City.

In making thin-wall cast-iron pistons it is necessary to use an iron containing about 2.75 per cent silicon, in order to prevent the metal from chilling in the skirt. This high silicon content, however, is conducive to the forming of shrink-holes in the boss of the casting. By lowering the silicon content to around 2.40 per cent, the shrink-holes may be closed, but the skirt of the casting is likely to contain hard spots and possibly a rim of white iron at the base.

By adding one-half of 1 per cent of nickel to this low-silicon iron, these hard spots can be eliminated without annealing, and the iron can be machined easily. When pistons are annealed to eliminate hard spots or white iron, the temperature required is so high that the iron is left in an extremely soft condition, characterized by a very low yield point, so that the pistons are easily distorted by normal handling operations. A piston in which the machineability has been secured by the addition of nickel, will be found to be of full strength and able to withstand considerable abuse without taking a permanent set. It also shows better wearing properties, especially in the ring grooves.

Nearly all the advantages gained by the use of nickel in cast iron can be utilized in automobile cylinders, heads, and exhaust manifolds. An increase in cylinder life of from 50 to 200 per cent, depending on the hardness of the alloy used has been found possible. Additions of 0.75 to 1 per cent nickel, with 0.30 to 0.40 per cent chromium, have increased the mileage obtained between the grinding of valves from five to seven times.

In heavy-duty engines, a minimum hardness of 220 Brinell on the valve seat has eliminated all trouble from valves "pounding in." This was secured by the addition of 1.50 to 2 per cent nickel, with 0.40 to 0.50 per cent chromium. Porosity in manifolds has been remedied by lowering the silicon 1/2 per cent and adding 1 per cent nickel. Cracking and growth in manifolds on heavy-duty units have been eliminated by using a low-silicon iron, with the addition of nickel and chromium.

Air-cooled aircraft cast-iron engine cylinders require an iron having sufficient fluidity to permit the fins to be cast properly. The fins must be gray; otherwise they will be brittle. The iron must also have good wearing properties. When the head is integral, the valve seats must maintain their hardness at the high operating temperatures encountered. With this condition, additions of 1 to 1.5 per cent nickel and 0.20 to 0.30 per cent chromium are commonly used, with 15 to 20 per cent steel scrap added to the cupola charge.

When the cylinder is a separate unit, a special iron of low carbon and high strength containing the following percentages can be used: Carbon, 2.90 to 3.05; silicon, 2.25 to 2.40; manganese, 0.75 to 0.90; phosphorus, 0.09 to 0.11; sulphur, 0.07 to 0.10; and nickel, 1.10 to 1.25 per cent. Test pieces of the same thickness as a cylinder cast from this metal show a minimum strength of 50,000 pounds per square inch.

The value of nickel in cast iron, especially in automotive cylinders, has been thoroughly demonstrated.

Promoting Permanent Prosperity

The plan proposed by Gerard Swope, president of the General Electric Co., for stabilizing industry, has received nation-wide attention. It is of the greatest significance that industrial leaders are devoting so much time and thought to this problem. Other plans have been and will be proposed. Whether any one of these will be adopted without modification, or whether the best features of all will be combined, is not the most vital point; what is vital is that we have a plan. In November MACHINERY the president of a well-known manufacturing plant in New England will outline a somewhat similar plan for attacking the problem of unemployment in the future. His plan, like Mr. Swope's, if generally adopted, would place industry in a position to do voluntarily and efficiently what our National Government otherwise would be likely to undertake in a manner that experience abroad has proved to be unsatisfactory and inefficient. Every plan suggested should be given most earnest consideration by every executive in the industries throughout the United States.

* * *

The Real Meaning of Mass Production

History shows that no government was ever overthrown by revolution when the masses of the people were enjoying prosperity and the standard of living was constantly being raised. The method of raising the standard of living is at hand through modern industry. Mass production and mass distribution has become a business fact. It is the inevitable next step confronting industry. In using the expression "mass production," it should be noted that innumerable instances of so-called mass production in the past have only, in reality, been large-scale production. Mass production involves not only large-scale production, but production, the object of which is the reduction of costs and prices. The step toward such mass production and mass distribution is a step that must be taken if we are to have peace, profits, prosperity, and stable governments; and it is a step that must be planned for on a world scale and on a groundwork of facts rather than on opinions and guesswork.—*E. A. Filene at the World Conference of Economists in Amsterdam, Holland*

New Shop Equipment

Latest Developments in Machine Tools, Unit Mechanisms, Machine Parts and Material Handling Appliances

Mattison Precision Surface Grinding Machine

A number of unusual features are embodied in a 16-inch high-powered precision surface grinder recently developed by the Mattison Machine Works, Rockford, Ill. The rotor of the motor that drives the grinding-wheel spindle is mounted directly on the spindle. There is a double column mounting for the wheel-head. Hydraulic power is employed for feeding the table and work under the grinding wheel and for feeding the wheel transversely across the work. This machine has been designed with a view to providing a considerable work range, a large amount of power, and great rigidity.

The built-in motor for the grinding-wheel spindle provides a simplified drive, practically eliminates vibration, and delivers the full power direct to the wheel. The motor is of 25 horsepower rating.

The wheel-spindle and motor are mounted in a housing carried on horizontal ways of the wheel-slide assembly. This unit, in turn, is supported between two heavy columns, as shown in the illustrations. In this design there is no overhung construction and no danger of spring when the machine is operating under severe service conditions.

A hydraulic pump mounted on a bedplate at the rear of the machine provides power for the feeds. The stroke of the longitudinal table travel is adjustable through table reversing dogs. The speed of the table may be varied from 30 to 90 feet per minute.

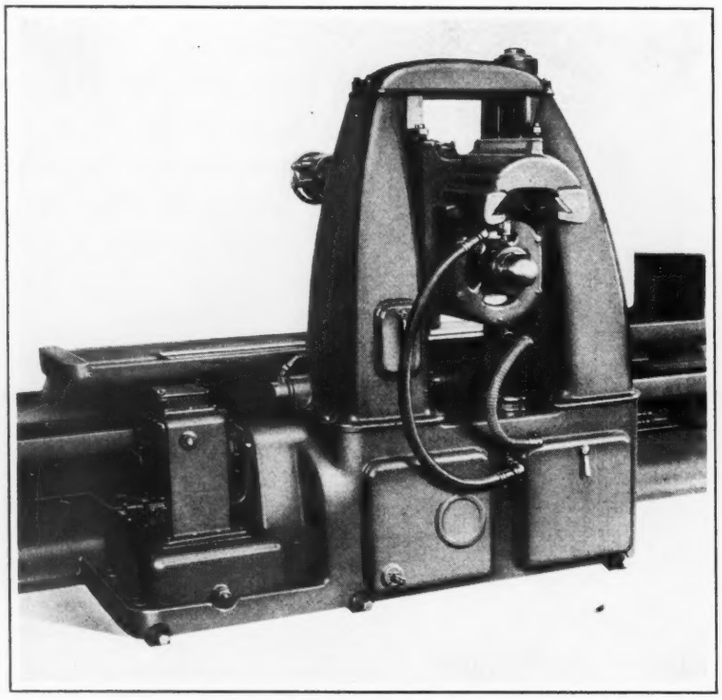
The hydraulic transverse feed of the wheel is entirely automatic, and is adjustable over the wide range of from 1/8 to 2 inches at each reversal of the table. This feature permits the use of feeds that take full advantage of the 6-inch face grinding wheel. Both quick-acting and low-geared cross-feeds, with automatic reversal, can also be operated by a handwheel, either for grinding or for truing.

All operating and adjusting levers, handwheels, and electric push-buttons are at the front of the machine within convenient reach of the operator. Raising of the wheel from the work is accomplished electrically through a push-button at the end of the clutch lever. As a result, the hoisting motor is started and the power clutch engaged without the operator having to change the position of his hand. Downward movement of the wheel is controlled through a separate push-button so arranged that the travel continues only while the operator holds the button depressed. This enables him to spot the wheel just above the work. Final adjustment for grinding is made through a handwheel and stop with a micrometer adjustment of 0.0001 inch.

Reversal of the wheel-slide travel is accomplished automatically, both with hand and hydraulic feeds, by means of two dogs on a circular disk. These are located directly in front of the operator where they are easily adjusted. This mechanism also serves as a quick means for locating the wheel in the center of work.

The working surface of the table is 16 inches wide, and may be 6, 7, 8, 10, or 12 feet long. The wheel-head can be adjusted vertically to allow a distance of 17 inches between the table surface and a 14-inch diameter wheel. A supplementary table, special fixtures, or a magnetic chuck can be attached to the regular table by means of the T-slots.

Ball bearings are used throughout the machine except for the grinding-wheel spindle, which is ordinarily mounted in easily adjusted tapered bronze bearings; however, ball bearings can also



The Double Column Construction and Arrangement of the Wheel-slide Assembly on the Mattison Surface Grinder

be supplied for this spindle if desired. Automatic force-feed lubrication is furnished for the table ways, and all ball bearings are oiled by splash lubrication.

All motors are enclosed, fan-cooled, and protected against oil, water, and metal dust. The operation of one push-button starts both the wheel-spindle and pump motors. Overload and under-voltage protection is provided for all motors, and all internal wiring is contained in metal conduits. The base of the machine is arranged with compartments to hold coolant tanks, the motors that drive the hydraulic and coolant pumps and the hoist mechanism, and the magnetic switches.

"Tom Thumb" Machine with Rotary Die-Head

A "Tom Thumb" pipe and bolt machine similar to the one that was described in October, 1930, MACHINERY, page 151, except that it is equipped with a rotary die-head, has been placed on the market by the Oster Mfg. Co. and the Williams Tool Corporation, Cleveland, Ohio.

The regular pipe capacity of this machine includes all sizes from 1/2 to 1 1/4 inches, but extra capacity down to and including 1/8 inch can be provided for. Similarly, the regular bolt capacity is from 3/8 to 1 1/4 inches, but an extra capacity can be made available for 1/4-, 5/16-, 1 3/8-, and 1 1/2-inch bolts. The machine can be furnished with special equipment for handling pipe nipples.

Bliss Four-Crank Press

Large dies used in automotive body work are usually unsymmetrical, a fact that often causes the center of pressure to be well away from the center of the press in which the dies are used. In the ordinary double-crank press, this is unimportant as long as the center of pressure lies near the vertical plane of the shaft. However, when the center of pressure is far from this plane, and off center in a front-to-back direction, heavy loads are imposed on the slide gibs, so that difficulties are experienced with the dies and with wear of the slide and gibs.

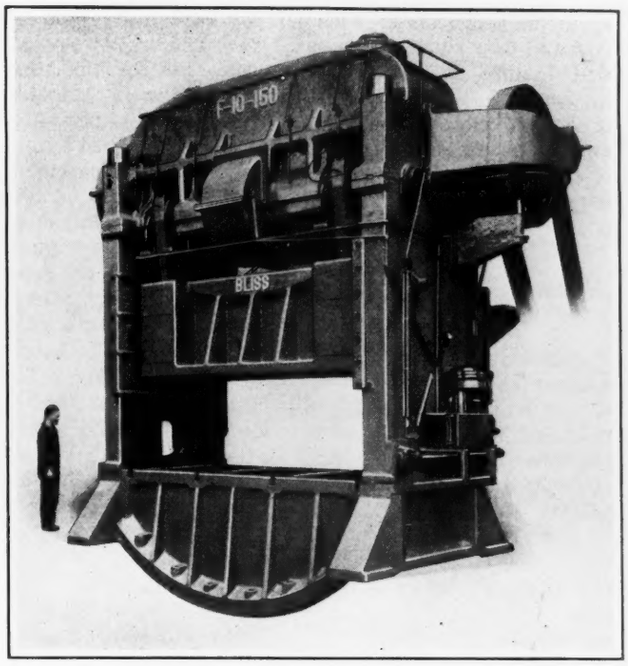
An improved press designed to meet such conditions has recently been built by the E. W. Bliss Co., 53rd St. and Second Ave., Brooklyn, N. Y. It is called a "four-crank" press (four-point suspension), because it has two double crankshafts which, geared together to revolve in step, distribute the pressure of their four pitmans to the four corners of the slide. With this design, the gibs are relieved from restraining any tendency of the slide to tip and have only to take care of the lateral forces.

This press has rather more than the usual bed area (70 by 150 inches). The crown has a cored box section with a vertical web over each shaft. Each shaft thus has its own beam, which is stiffened to an unusual degree by connecting flanges and diaphragms. The tie-rods pass outside the shafts through broad uprights in order to insure stability of the frame. Further stiffness is imparted to the uprights by the absence of cored openings for heating the tie-rods, these openings being in the bed.

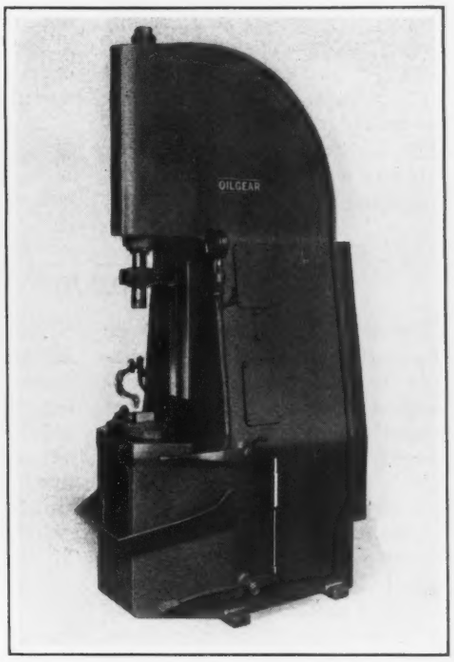
The pitmans are solid or non-adjustable. Slide adjustment is effected through four screws attached to slidable wrist-blocks, which are fitted to bored holes in the slide. The nuts for the screws are the rotating members, and are geared back to an adjusting motor on the slide. Through a patented locking mechanism the pressure surfaces of the screws and nuts are seated firmly.

In addition to the usual elements, the drive of this press requires gearing to make the two crankshafts revolve in step. They rotate in opposite directions, so that the lateral forces on the slide caused by the angularity of the connecting-rods balance each other.

A circulating oil system built into the press includes a motor-driven pump which delivers the oil from the supply tank through a filter to a supply main. Sight-feed regulators connect the main



Bliss Press with Two Double Crankshafts which Distribute the Pressure Uniformly to the Four Corners of the Slide



Oilgear "Streamline" Press for Assembling, Broaching, Forcing, and Other Operations

with every bearing, while larger quantities of oil are fed to the two gear trains. The oil drains back to the supply tank. An advantage of the separate motor drive for the oil pump is that all bearings can be filled with oil before the press is started.

The important specifications of this press include the following: Distance from bed to slide, with the stroke down and the adjustment up, 36 inches; length of stroke, 10 inches; slide adjustment, 6 inches; distance between uprights, 150 inches; floor space, 11 feet 10 inches by 20 feet 10 inches; and net weight, 250,000 pounds.

Oilgear "Streamline" Presses

A series of "Streamline" presses for assembling, broaching, forcing, and general manufacturing operations has been developed by the Oilgear Co., 1403 W. Bruce St., Milwaukee, Wis. From the illustration it will be seen that the entire operating mechanism, including the Oilgear pump, electric motor, lubricant pump, piping, and control, is enclosed in the frame structure. These machines can be provided with either variable-delivery, constant-pressure pumps or constant-displacement Oilgear pumps and suitable control equipment.

The frame is a one-piece heavy-weight welded steel structure, and a welded steel guard covers the rear portion. The hydraulic cylinder tube is honed and the piston and piston-rings are fitted in place. The ram is ground and polished and is guided in the front head. Special molded ram packing eliminates leakage. A direct-reading gage shows the working pressure.

Hand-lever and foot-pedal controls, semi-automatic or full automatic, are furnished as standard equipment. Any required ram speed within the capacity of the machine can be obtained by moving the hand-lever or foot-pedal, when a variable-delivery pump and the semi-automatic control are used. The ram can be started or reversed instantly, and is controlled by adjustable dogs. Full-automatic control permits a continuous ram motion of any desired stroke, which can be started and stopped by the operator whenever necessary.

When a constant-pressure pump is employed, the ram can be stalled and the maximum pressure held continuously without overheating or loss of power. The ram speed can be varied by means of a convenient external adjusting screw. When a constant-displacement pump is used, the ram speed is constant.

These presses are manufactured in 2 1/2, 3 1/2, 6, 10, and 15-ton capacities.

Haynes Stellite J-Metal

A special grade of Stellite recently developed by the Haynes Stellite Co., Kokomo, Ind., for cutting cast iron, semi-steel, and steel has been given the name of "J-metal." Tests conducted in actual production operations have shown that this metal, with the same feed and depth of cut used for turning cast iron and semi-steel with Grade 3 Stellite cutters, will operate at a maximum speed 50 per cent greater than was formerly possible for the most efficient results. At this higher speed, the number of

pieces per grind equals that normally obtained at slower speeds.

At the same speed, feed, and depth of cut, J-metal shows an increase in cutting life of at least 100 per cent over Grade 3 Stellite, and a ratio of 4 to 1 over the number of pieces formerly obtained per grind. The metal shows the same superiorities over standard Stellite in steel cutting operations.

Stocks of J-metal are available in standard sizes of tool bits, welded tools, and milling-cutter blades.

Cleveland 500,000-Pound Press

The Cleveland Punch & Shear Works Co., Cleveland, Ohio, has recently built for a leading automobile manufacturer a press that weighs approximately 500,000 pounds and that required six cars for shipping. Instead of the customary single shaft with two cranks located in the center of the slide, this press is provided with twin shafts and has four cranks at the extreme corners of the slide. The design eliminates any tendency of the slide to rock under the maximum load, and insures continuous accuracy. Another important feature of the machine is a slide adjustment of from 0 to approximately 24 inches.

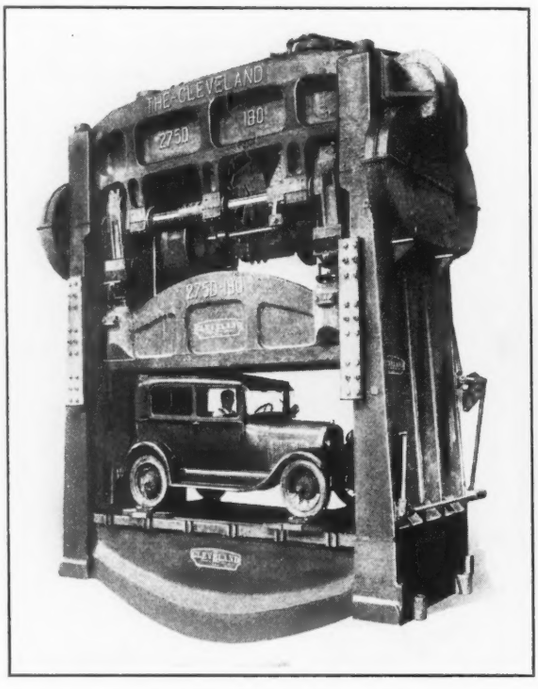
It will be seen from the illustration that the bed of this four-point suspension press is large enough to accommodate a complete automobile. The bed casting is made of steel, weighs 103,000 pounds, and has an overall length of 220 inches. The flywheel alone weighs 5 tons. Instead of the four steel tie-rods customarily used to combine the crown, bed, and uprights into one complete unit, this press has eight tie-rods, four on each side.

The press has a capacity of 600 tons. It is controlled by one operator through a push-button station; however, there is also an auxiliary hand control to facilitate the accurate setting of dies. Roller bearings are used throughout the press construction, except for the crankshafts. These run in special oil-tight removable bronze bearings. The press is intended for use in the production of automobile stampings, such as side and quarter panels and cowls. It can be furnished in any size.

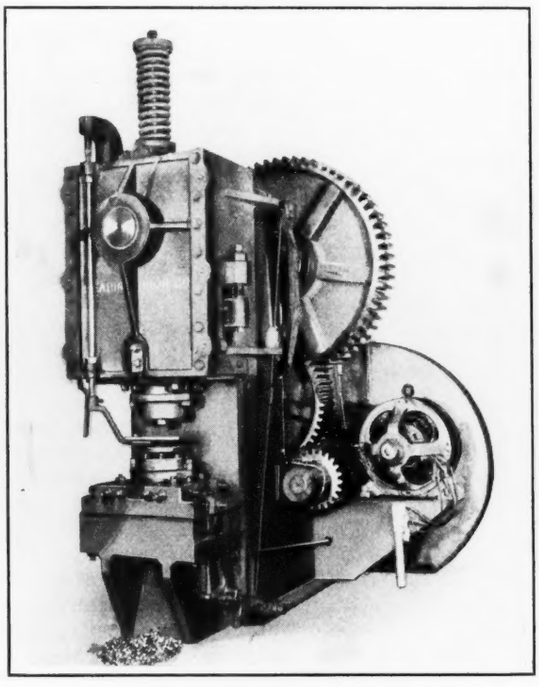
Reading Press of All-Welded Rolled-Steel Construction

In cooperation with engineers of Lukenweld, Inc., Coatesville, Pa., the heavy machinery and hydraulic equipment department of the Reading Iron Co., Reading, Pa., recently built the heavy-duty punch press here illustrated. This press exerts a ram pressure of 525 tons. It is capable of cold-punching, at one stroke, complete washers up to 6 inches outside diameter and 3 inches inside diameter from rolled-steel plate up to 5/8 inch thick.

A mechanism ejects the punched washers from the dies and places them on a throw-out arm from which they are de-



Huge Press Recently Built by the Cleveland Punch & Shear Works Co.



All-welded Press Designed for Cold-punching Large Washers at One Stroke

posited in a receptacle at the side of the machine. Power is provided by a 25-horsepower motor. The maximum speed of the ram is 40 strokes per minute for small washers and 20 strokes per minute for large washers.

An important feature of this machine is the arc-welded steel construction of the housing, outboard-bearing stand assembly, gears, pinions, flywheel, and other parts. A reduction of over 2 1/2 tons in the total weight of the press is said to have been made by this construction, as well as a substantial reduction in costs.

Van Norman No. 11 Milling Machine

The latest improved milling machine to be added to the line of the Van Norman Machine Tool Co., Springfield, Mass., is the No. 11 here illustrated. This machine supersedes the No. 10 described in September, 1924, MACHINERY, page 72, which, in turn, replaced the No. 1/2 old type miller driven by a countershaft.

In the new machine is incorporated the adjustable pivoted cutter-head, mounted on a ram that slides in a horizontal plane, which is a standard feature of all millers built by this company. The cutter-head can be fixed at any angle from the horizontal to the vertical, while the ram can be adjusted in or out to bring the cutter into any desired position above the work.

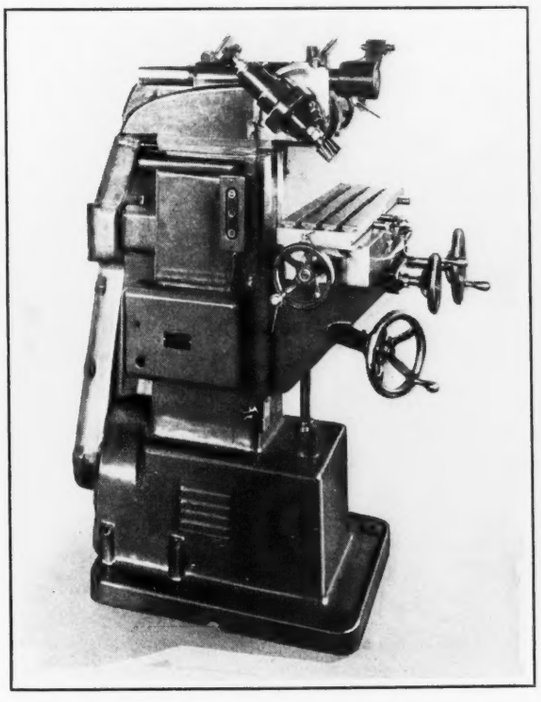
New features of the machine include a built-in-base motor drive similar to that used in the No. 21 machine described in June, 1931, MACHINERY, page 795. Power is transmitted to the spindle and feed-box through an enclosed roller silent chain.

This machine is designed to meet the requirements of experimental rooms, tool-rooms, die and fixture work, etc. "Semi-Index" centers can be used, as well as the high-speed milling attachment made by the company. Six spindle speeds ranging from 50 to 500 revolutions per minute are available, as well as eighteen table feeds ranging from 1/4 inch to 14 5/8 inches per minute.

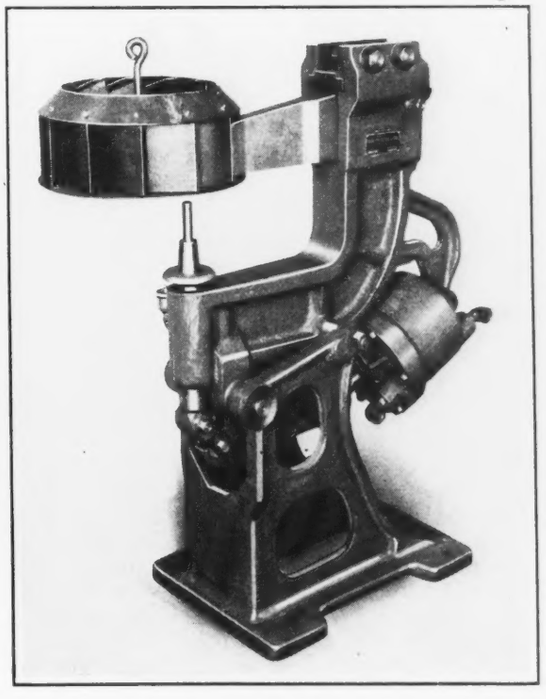
Other important specifications of the machine are as follows: Ram adjustment on column, 8 inches; length of automatic table movement, 16 inches; amount of hand cross-feed, 6 1/2 inches; maximum distance from center line of horizontal arbor to top of table, 15 inches; maximum distance between top of table and standard end-mill with head vertical, 8 1/4 inches; maximum distance from face of column to center of spindle with head vertical, 7 inches; and weight of machine without motor but including standard equipment, about 1675 pounds.

Hanna Riveter with Four Stakes

The Hanna Engineering Works, 1765 Elston Ave., Chicago, Ill., recently built the equipment illustrated for use in the fabrication of blower rotors. This machine is employed for



Van Norman Small-size Milling Machine with Motor-in-Base Drive



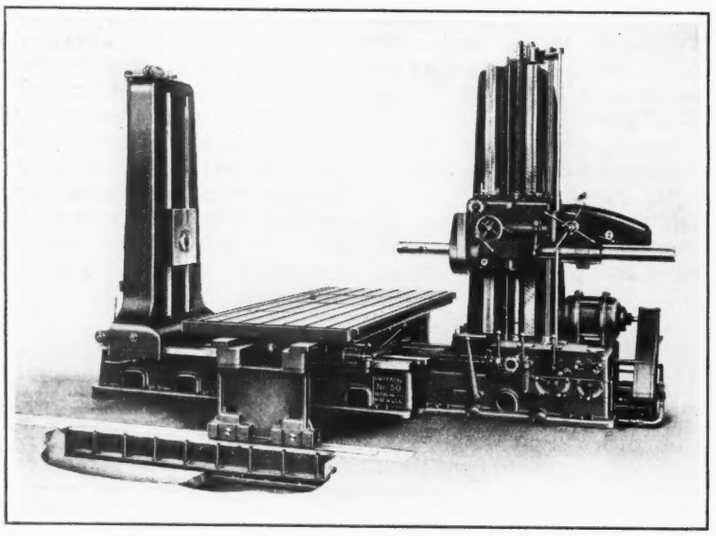
Hanna Riveter in which Four Stakes can be Interchanged Rapidly

driving the rivets that attach the curved blades to the circular side plates, and they are driven cold.

The back plate is flat, and the rim plate conical. The riveter "buck-up die" stake, which enters between the plates and the blades, must be one shape for rivets in the flat back plate and another for rivets in the conical rim plate. As the rotors may be for right- or left-hand rotation, the blades may rotate clockwise or counter-clockwise; consequently, two pairs or four distinct stakes are required.

These four stakes can be interchanged with unusual rapidity. The accuracy and rigidity essential in mounting the stakes is provided by two bolt-drawn wedges and two bolts which grip the stake between the two side walls of its slot in the main frame.

Ordinary variations in rivet lengths and plate thicknesses are automatically taken care of by the uniform pressure range of the die stroke.



Universal Boring Machine with End Support for the Carriage

Universal Boring Machine with End Support for Carriage

A No. 50 horizontal boring machine of considerably increased range has recently been added to the line of machines built by the Universal Boring Machine Co., Hudson, Mass. This machine has a table with a working surface 60 inches wide by 144 inches long, and a power cross-feed of 120 inches. The maximum distance from the top of the table to the center of the bar is 84 inches, and the maximum distance between the faceplate and outer support, 14 feet. The spindle has a continuous feed of 30 inches, and with one resetting, a feed of 60 inches.

To provide for supporting the work properly when the table is at the extreme positions, the ends of the carriage are supported on two rails set in the foundation. These rails have hardened steel surfaces. Spring-controlled scrapers and wipers keep the rails free from chips. The rail itself is of two-piece construction, the lower piece being grouted in place in the foundation, while the upper half is adjustable in order to bring it into alignment with the machine bed. The carriage ways are 44 inches longer than the table, so that in the extreme positions, two-thirds of the table is supported by the carriage. Loads of 12 to 15 tons do not cause serious deflection.

The rear post assembly is of a heavy design employing a double-vee construction and a counterbalanced slide. The rigid design permits the advantageous use of over-arm attachments for slab or vertical milling.

The spindle sleeve is mounted in tapered roller bearings, while the drive members from the driving sprocket to the spindle sleeve are equipped with ball or roller bearings. Power-driven pumps in the gear-boxes and head, together with one-shot oiling systems on the table, carriage, and rear post assemblies, reduce to a minimum the attention required for oiling.

All controls are conveniently located for the operator. Clamps are provided for all units, the carriage being clamped to the bed both at the front and rear from a position directly in front of the operator. This machine is built in several combinations of length between the faceplate and outer support, size of table, and maximum distance from top of table to center of bar. The net weight of the machine illustrated is 68,000 pounds, while the weight of a machine of maximum dimensions is 78,000 pounds.

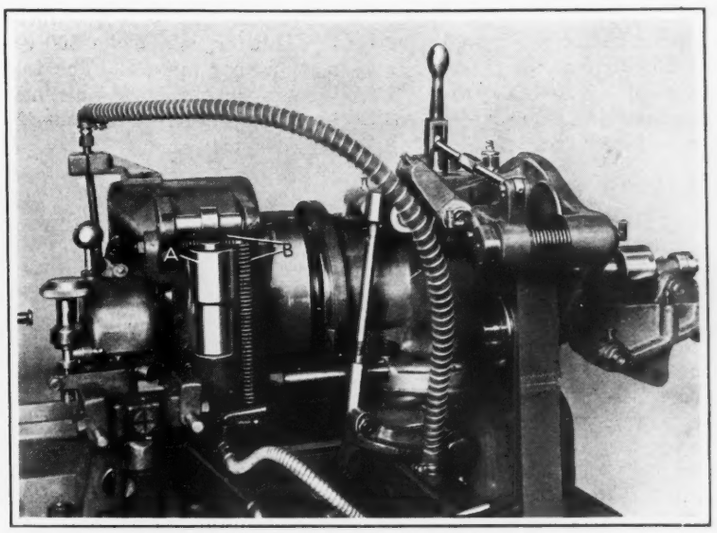
Heald Internal Grinder Attachments

For high-production internal grinding operations, it is the practice of the Heald Machine Co., Worcester, Mass., to furnish fixtures that load from the front, so as to obviate the necessity of opening the chuck guard each time a piece is loaded. In some cases, however, side-loading balloon-type fixtures are furnished either through necessity or because of a preference on the part of the customer. Production then suffers because of the increased handling time.

To eliminate this loss of time, the concern recently developed an automatic chuck guard which is applicable to all No. 72A internal grinding machines on which a standard guard is used. This guard is operated by means of a valve, cam, and oil cylinder mounted on the back of the

guard in the manner indicated at *A* in the illustration. The valve is normally held open by means of a spring, allowing pump pressure to be exerted against the piston in the oil cylinder, so as to hold the guard closed against the pressure of springs *B*. When the table runs out to the rest position, the valve is depressed by the cam to allow the oil to exhaust from the cylinder. Springs *B* then open the guard. Reversal of the table and the consequent release of the valve cause the pump pressure to automatically close the guard.

The work-head spindle of motor-driven No. 72A internal grinding machines can now be freed from its driving mechanism so that it can be turned by hand. This feature is obtained by means of "neutral-position" equipment recently designed by the company. It is of especial value in setting up the machine, and is said to be almost a necessity when balloon-type fixtures are used. The new equipment that permits this neutral position can be seen at the right-hand end of the illustration. It consists of a lever coupled to the arm that carries one of the work-head belt idlers. When the lever is pulled out and down, the belt slackens sufficiently to allow the work-head spindle to turn freely.

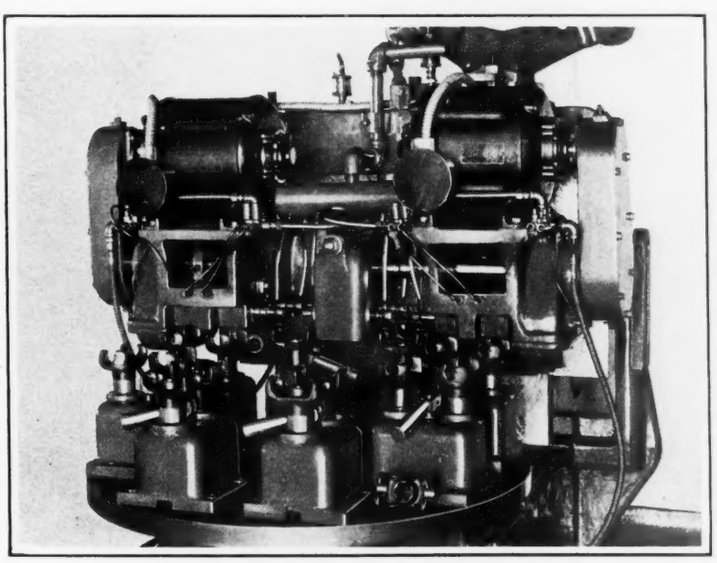


Heald Internal Grinder Equipped with Automatic Chuck Guard and Having a Neutral Work-head Position

Producto-Matic for Milling Universal Joints

A specially designed head for milling spring grooves in universal joints for automobiles has been brought out by the Producto Machine Co., Bridgeport, Conn., to be applied to the company's Producto-Matic.

The joints to be milled are made in two lengths. The machine and fixture are so designed that two grooves in each of four pieces—two long and two short joints—are milled at one time. This is accomplished by the use of three cutter-heads, two having two spindles each and one having four spindles. The work is carried on a four-station index-type table, each station having two fixtures. Each of these fixtures carries two parts—a long and a short joint. The parts to be milled are placed in position by the operator, and are located by their splines. They are then automatically clamped by the machine. After milling, they are released by manipulating a hand-lever.



Special Head and Indexing Fixture for Milling Universal Joint Spring Grooves on the Producto-Matic

The cutter-heads are mounted on a vertical slide, the cutters being fed downward only. The cutter-head to the left has an individual motor which drives through a silent chain; the head to the right and the center head are both driven from one motor, also through a silent chain. Each motor is of 1 horsepower and runs at 1800 R.P.M.

The indexing and feeding movements are actuated by a third motor of 3 horsepower, mounted in the base of the machine. This motor also furnishes power to the pump, which provides 10 gallons of cutting com-

pound a minute to the cutters. Lubrication of the spindles and spindle drives is obtained by means of a one-shot system. The transmission is provided with forced-feed lubrication.

The cutters are 1 1/8 inches in diameter, and make 500 revolutions per minute. The table indexes 200 times per hour, making the total production, 800 pieces hourly.

Hammond Grinding and Polishing Equipment

The tool, casting, and general-purpose grinder recently brought out by Hammond Machinery Builders, Inc., Kalamazoo, Mich., differs from the conventional type of electric grinder in that the power is transmitted from the motor to the spindle by means of multi-V-belts. The motor is mounted at the rear of the pedestal, as will be apparent from the illustration.

One of the advantages claimed for this construction is a spindle housing of small diameter, which gives a considerable amount of clearance between the periphery of the grinding wheels and the spindle housing. Another advantage is that several of these machines can be installed in tandem fashion and operated at different speeds, inasmuch as the spindle speed is not limited to the speed of the motor.

This machine can be supplied with 10-, 12-, 14-, or 16-inch grinding wheels and in 1-, 2-, 3-, and 5-horsepower capacities. The motor is totally enclosed, and is ventilated by means of a patented air cleaner.

Grinding, polishing, and buffing machines made by the same company can now be equipped with a patented variable-speed pulley capable of transmitting up to 15 horsepower. This pulley has a ratio of 1 1/3 to 1 (greater ratios if two or more pulleys are used), which makes it possible to obtain an unlimited number of speeds in this ratio. The maximum number of revolutions per minute recommended is 3000.

For polishing and buffing lathes, speeds of 2000 to 3000 or 1800 to 2700 revolutions per minute can be supplied. An especial advantage of the pulley on high-speed grinders is that the proper peripheral speed of the grinding wheel can be maintained as the wheel wears. For 24-inch wheels, a speed range of from 1600 to 2400 revolutions per minute is provided so as to maintain a surface speed of 9500 feet per minute until the wheel is worn to 13 inches.

Fig. 2 shows an automatic composition feeder also developed by the Hammond Machinery Builders, Inc., for use on polishing and buffing machines of full-automatic, semi-automatic, and hand types. With this device, compressed air is used to deliver the composition paste through a distributing nozzle direct to the polishing or buffing wheel. The centrifugal force of the wheel carries the composition to a collector pad clamped on one end of the nozzle, which presses against the wheel. The desired amount of composition can be fed either at a constant rate or intermittently.

Fig. 1. Hammond Grinder with Multiple V-belt Drive from Motor to Spindle

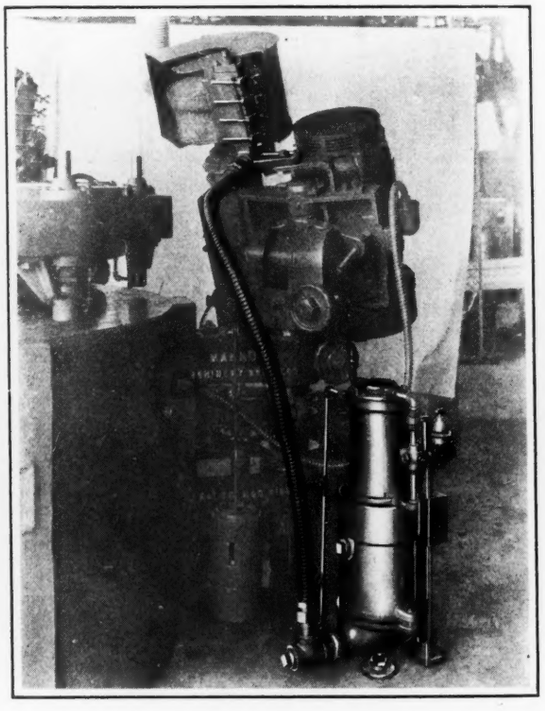


Fig. 2. Equipment for Feeding Composition Paste to Polishing and Buffing Wheels

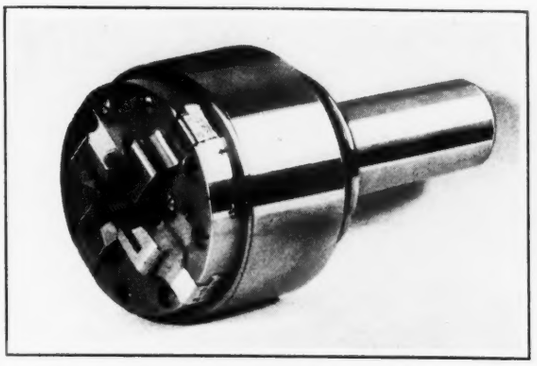


Fig. 1. H & G Die-head Designed for Using Insert-type Chasers

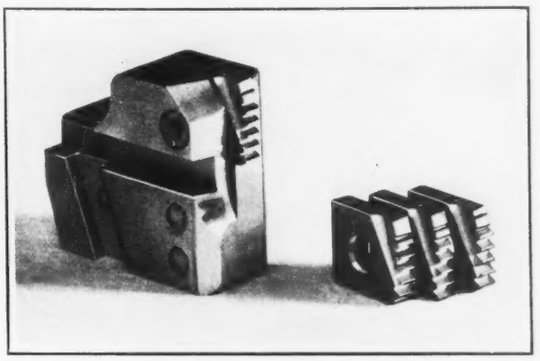


Fig. 2. Carrier and Chaser Inserts for H & G Die-heads

H & G Die-Heads with Insert-Type Chasers

An entirely new feature in self-opening die-heads has been developed by the Eastern Machine Screw Corporation, New Haven, Conn. To avoid the difficulties encountered in regrinding thread chasers, a design has been developed making regrinding and sharpening unnecessary. Instead of using large chasers intended to be reground many times, carriers are substituted, taking small high-speed steel inserts. These inserts are held in place by a single screw and have a draw-in feature which locks the insert in the carrier in such a way that it will always be accurately located to insure "trackage." As the inserts are small, they are comparatively inexpensive. They can be replaced in a few seconds by anyone who can read the figures 1, 2, 3, and 4.

The die-heads for the use of these chasers are made in three sizes. The smallest size covers a range of diameters of from 1/4 to 1/2 inch, while the two larger sizes each cover a diameter range of from 1/4 to 1 inch. The carriers are made in three ranges—one for threads up to 1/2 inch in diameter, another for diameters above 1/2 inch up to 3/4 inch, and a third for sizes above 3/4 inch up to 1 inch. The same carriers are used for both the coarse- and the fine-pitch series, since the correct helix angle is provided for in the chaser insert. The chaser inserts for cutting a given thread can be used in any size of the new type of die-head. The carriers themselves are larger than the usual chasers, and hence have a much greater amount of wearing surface.

These die-heads with chaser inserts have been in use for a considerable length of time on production jobs. It is stated that because of the possibility of making the insert type of chaser so that the clearance and cutting action are as theoretically correct as possible without any consideration being paid to designing it so that it will function after regrinding, these chasers have proved themselves capable of cutting a larger number of accurate threads than has been possible with the older type of chaser between each grinding.

When the insert chasers have been run to a point where the threads do not meet inspection requirements, a new set is inserted almost instantly, and accurate threads are again cut with no adjustment for the length of thread. Ordinarily, in changing chasers, it is not even necessary to screw a gage into the die-head to adjust for size. The insert chasers can be removed at the machine without taking the carriers out; or the carriers, with the inserts, can be removed and the change made at the bench.

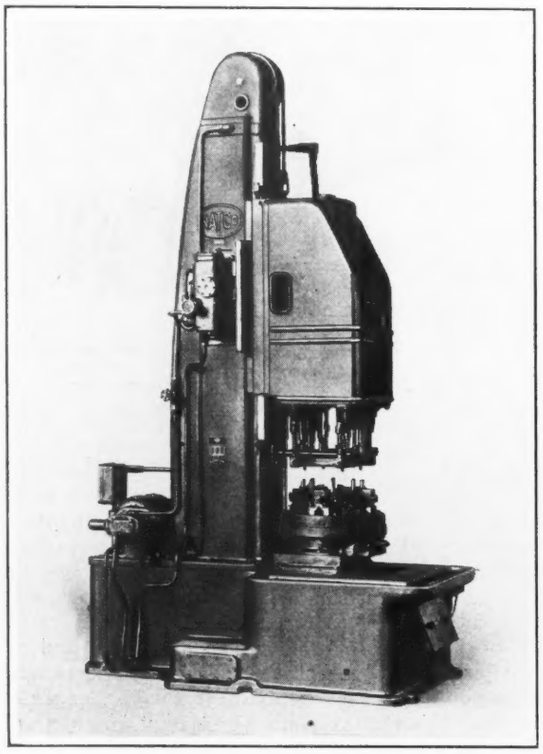
Natco Hydraulic Drilling Machine

The National Automatic Tool Co., Richmond, Ind., has brought out a new hydraulic "driller" designed to have the least possible number of parts. It is arranged for fixed-center heads only, and compares in capacity with the standard Natco 6-inch horizontal hydraulic unit.

This machine can be provided with either a high or a low base. The high base has a working surface of 36 by 29 inches, approximately 24 inches above the floor line. It is provided with chip chutes, and there is a clean-out hole in the front for removing the chips. The low base has a working surface of 36 by 32 inches, approximately 9 1/4 inches above the floor line. This base is intended for use with high fixtures, or when a box or rotating table is desired. The rear section of both bases serves as a mounting platform for both the column and the hydraulic pumping unit. The base contains a reservoir for the hydraulic system.

Fixed-center cluster heads are mounted in the usual manner on the head slide. They are backed up by a motor housing which takes the major portion of the drilling thrust. The motor used for driving the cluster heads is a vertical side-mounted motor. Space is provided for motors up to 10 horsepower.

The hydraulic pump unit consists of a motor connected to a constant-pressure pump. For a pressure up to 200 pounds per square inch, a three-horsepower motor is recommended, and for special applications up to 300 pounds per square inch, a five-



Natco Hydraulic "Driller" Designed for Fixed-center Heads

Hutto Vertical Internal Grinding Machine Designed for Heavy Work

horsepower motor is recommended. The 6-inch diameter cylinder provides 18 inches of travel, any portion of which can be used for various feeding rates up to 15 inches per minute. The rapid traverse rate is approximately 80 inches per minute.

The operator starts the cycle of the machine by merely pulling an air-valve handle, after which the operation is completely automatic. The approximate weight of this drilling machine, without cluster head and fixtures, is 8000 pounds.

Hutto Vertical Internal Grinding Machine

A vertical internal grinding or honing machine just brought out by the Hutto Engineering Co., Inc., 515 Lycaste Ave., Detroit, Mich., is shown in the accompanying illustration. This machine has been designed primarily for the finish-grinding of heavy work, such as cylinders for trucks, airplanes, marine engines, Diesel engines, and air compressors. It has a wide range, having a capacity for finishing bores from 1 1/2 to 8 inches in diameter and up to 18 inches in length.

Four reciprocating speeds and two rotating speeds are available for the spindle, making it possible to obtain any desired finish in all bores. The vertical motor which supplies the power is instantly controlled through a remote-control automatic starter. The head is raised and lowered by means of a convenient crank. It can be locked in place at the desired height. The driving spindle is telescoped to permit the grinder to be removed from the bore without disturbing the setup. The stroke adjustment mechanism is easily accessible by lifting off the front plate.

The table contains a reservoir having a capacity for 45 gallons of coolant, which is supplied to the grinder and work by means of a motor-driven pump. Quiet operation is insured by a self-lubricating system. Ball bearings are used throughout the machine, with the exception of the phosphor-bronze spindle bushing. This vertical grinding machine occupies a floor space of only 40 by 54 inches.

Moline Lapping Machine of Fabricated Construction

A single-spindle lapping or honing machine of fabricated steel construction has recently been added to the line of machines built by the Moline Tool Co., Moline, Ill. This machine is equipped with a new type of combined hydraulic cylinder and spindle.

The column is made of a pipe 10 3/4 inches outside diameter. Welded to this pipe are two pieces of boiler plate, 1 inch thick. One plate is 12 inches

wide and extends the full length of the column to form the face. The other plate measures 15 by 16 inches and is welded to the lower end of the pipe to provide for bolting the base to the column. The base is of box section, and also serves as a coolant reservoir.

Power can be taken from a lineshaft or a motor to a driving pulley which is mounted on the horizontal shaft of a unit bolted to the face of the column. Within the driving pulley there is a clutch operated by means of a convenient lever for controlling the rotation of the spindle. Slip gears permit the use of different spindle speeds.

The spindle, which is also the hydraulic cylinder, is the only reciprocating member of the machine. It is made of seamless tubing and honed to a mirror-like finish. The piston-rod is also a tube. It is held stationary by a bracket.

The stroke of the spindle is adjustable up to a maximum of 24 inches. An Oilgear pump provides pressure for the spindle reciprocation, the rate of which is adjustable through a lever. The machine occupies a floor space of 40 by 60 inches. The working surface of the table measures 32 by 40 inches.

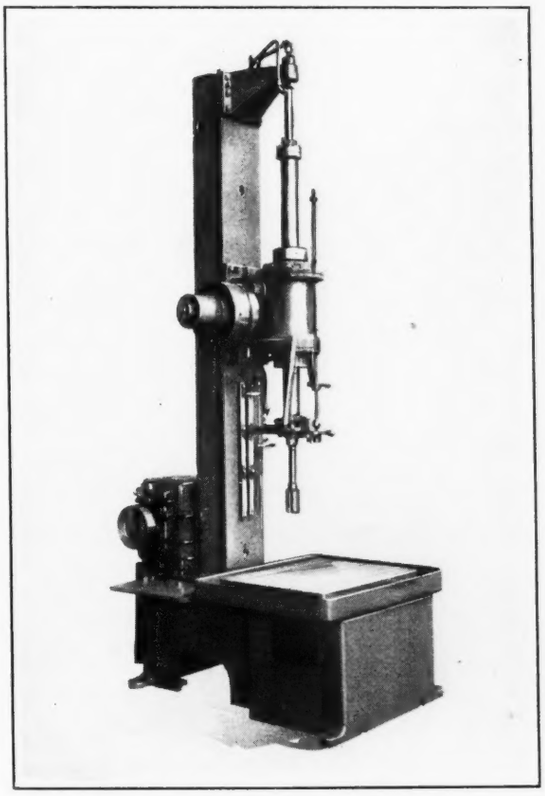
Rockford Multiple Drilling and Boring Machine

A flexibility that makes the machine readily adaptable to many jobs is one of the principal features of a heavy-duty multiple-spindle drilling and boring machine being placed on the market by the Rockford Drilling Machine Co., 209 Catherine St., Rockford, Ill. Even with this flexibility, it is claimed that the machine will give the high production usually obtained only with a single-purpose machine.

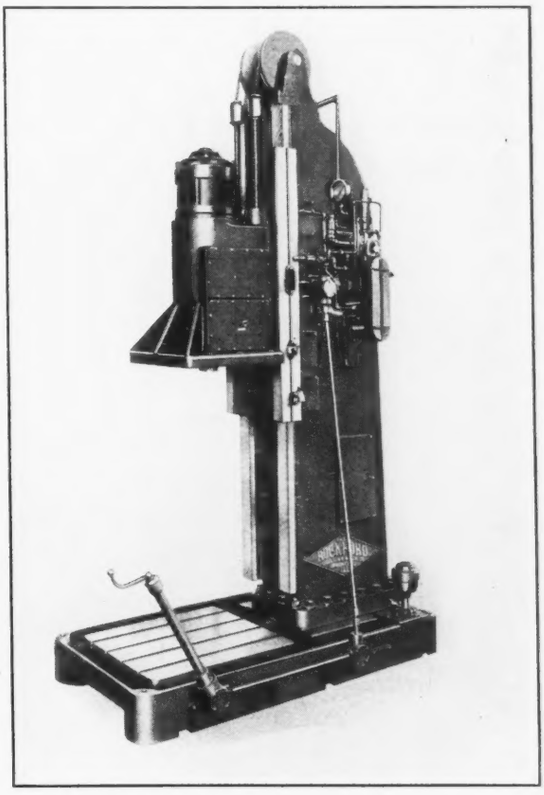
Multiple-spindle heads with the required number of spindles located at proper center distances are bolted direct to the face of the machine head to suit each job. The machine head is traversed hydraulically by means of an Oilgear pump driven by an individual motor. The automatic operation comprises a rapid traverse forward, a feed from a predetermined point, and a rapid return traverse. A second rate of feed, as well as a dwell, can be added to the cycle. Hand control of the head is also available.

The position of the head on the column can be varied, and a travel of 24 inches is available from any position. Speed changes covering a wide range can be obtained through pick-off gears. Weights, which can be conveniently added to or reduced through an opening in the column, counterbalance the machine head and the multiple-spindle head.

The motor on the machine head drives direct through reduction gears to the main drive



Moline Lapping Machine Built of Steel Pipe and Plates Welded Together



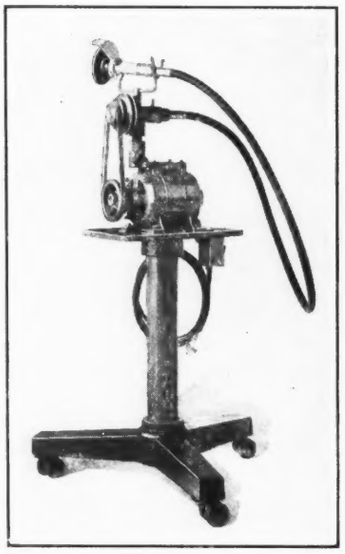
Rockford Machine Designed for Quick Attachment of Multiple-spindle Heads

spindle. Timken tapered roller bearings are provided for this spindle. The base can be equipped with either a stationary or an indexing table.

McNeil Flexible-Shaft Machines

Flexible-shaft machines of the construction illustrated, together with tools and accessories, are being placed on the market by the McNeil Bros. Co., Cincinnati, Ohio. The Model M-2 machine is driven by a 1/2-horsepower ball-bearing motor, and has a capacity for a 6- by 3/4-inch grinding wheel, a 6- by 1-inch wire brush, a 9-inch sanding disk and drills up to 3/8 inch. The Model M-4 is driven by a 1-horsepower ball-bearing motor, and has a capacity for grinding wheels up to 8 inches by 1 inch, 7- by 1-inch wire brushes, 9-inch sanding disks, and drills up to 5/8 inch.

Three speeds are obtainable by means of a V-belt running on three-step pulleys. A roller bearing is provided for the countershaft, and either roller or ball bearings for the hand-pieces. An additional shaft can be furnished for form filing and light grinding. Rotary files of various shapes, felt and rubber wheels, wire brushes, and heavy-duty rasping tools are included in the line of tools handled.



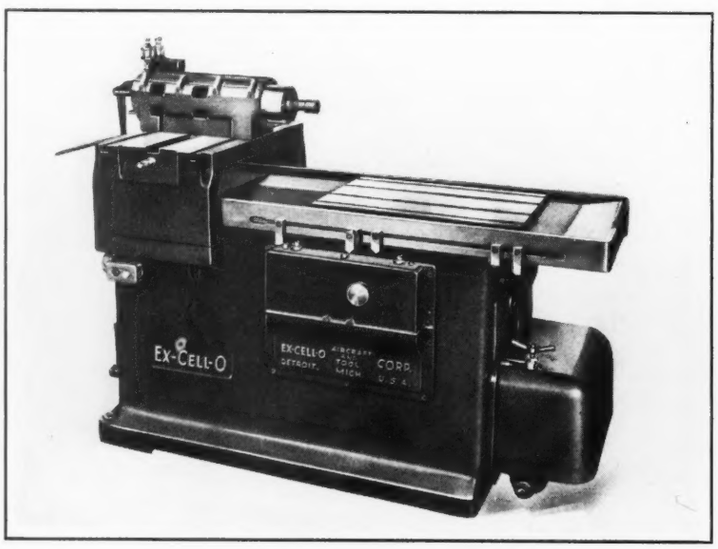
McNeil Three-speed Flexible-shaft Machine

Ex-Cell-O Small-Type Diamond Boring Machine

For cases where production requirements do not warrant using the large diamond or tungsten-carbide boring machine built by the Ex-Cell-O Aircraft & Tool Corporation, 1200 Oakman Blvd., Detroit, Mich., which was described in November, 1930, MACHINERY, page 229, the concern has now brought out the smaller model here illustrated. The new machine is of single-end construction, and is provided with one bridge to which one, two, or three motor-driven boring units can be attached. A screw located near the top and center of the bridge provides for quickly adjusting the boring units. Each of the boring spindles has a self-contained motor of 3/4 horsepower rating which turns at 3600 revolutions per minute. This motor is mounted on the spindle shaft and on the same mounting bracket as the spindle, thus eliminating belts, couplings, etc.

The table of this machine has a finished surface, 16 by 25 inches, to receive the work-holding fixture. The hydraulic unit that operates the machine, and the work fixture if desired, is driven by a two-horsepower ball-bearing motor running at 1200 revolutions per minute. This motor is located inside the machine and drives both the coolant- and oil-pumps. All oil must pass through a filter before it enters the hydraulic system.

This hydraulic system provides table feeds from 0.0005 inch per revolution of the spindle up. The table operation is controlled by dogs mounted in a T-slot on the front side, which control the fast and slow feeds in either direction and the reverse travel. The total weight of this machine, without a fixture, is about 3500 pounds.



Ex-Cell-O Single-end Boring Machine Designed to Use Diamond and Tungsten-carbide Tools

Cee-Bee Cleaning Compounds

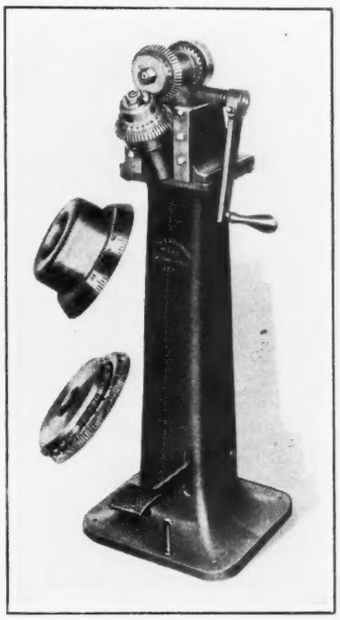
Cleaning compounds for industrial uses have been placed on the market by the Cee-Bee Laboratories, Ltd., 655-657 E. Gage Ave., Los Angeles, Calif. These compounds are said to contain no acidic preparations or other harmful ingredients. They do not combine with oil, grease, or dirt. They may be applied by hand, by immersion, by a pressure gun or by circulation.

Noble & Westbrook Graduating Machine

A machine has recently been constructed by the Noble & Westbrook Mfg. Co., 20 Westbrook St., East Hartford, Conn., for rolling graduations and figures on beveled micrometer collars. This machine, as illustrated, is a heavier model than those previously built by the concern, and embodies several improved features.

The marking die is carried on a spindle driven by hand power applied through spiral gears. The micrometer collar to be marked is mounted on a separate spindle which is set at the proper angle to bring the beveled marking die in proper relationship with the beveled micrometer collar. The spindles that hold the die and micrometer collar are accurately geared together. Pressure is applied through a cam concealed in the base of the machine. The cam is operated by the foot-treadle.

This machine can be arranged to mark collars of different sizes, provided the angle is the same on all sizes. A separate marking die, however, is required for each size of collar.



Noble & Westbrook Micrometer-collar Marking Machine

Other features of the machine include an improved type of ways and a method of lubricating the ways that increases their life. All the gears are enclosed in oil-tight cases. Rapid traverse of the carriage, both forward and backward, is provided, and there are automatic stops at each end of the travel. This self-contained machine can be mounted on a circular base if desired.

Ramet "Toolpak"

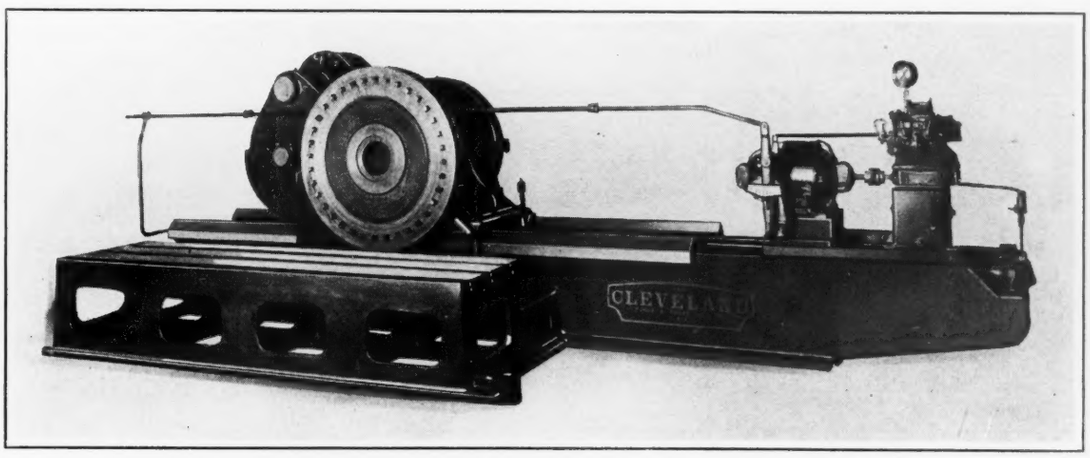
In March MACHINERY (page 540) was published an article describing Ramet, a new high-speed cutting metal in which tantalum is the principal constituent. The Ramet Corporation of America, North Chicago, Ill., has now brought out a "Toolpak" consisting of five Ramet-tipped tools, a tool-holder, and a special grinding wheel, all of which are packed in a finished wooden case. Two right-hand, one left-hand, one round-nose, and one grooving tool are included. This "Toolpak" makes available to the smaller shops Ramet tool bits that will handle a wide variety of work.

Cleveland Hydraulic Rotary Planer

The carriage of a rapid-production rotary planer recently built by the Cleveland Punch & Shear Works Co., Cleveland, Ohio, is traversed hydraulically, thereby providing an infinite number of feeds. A feed selector can be set to make any two feeds within the range instantly available. This feature is particularly desirable when thick and thin sections are encountered, as in the machining of heavy structural members. The cutter-head, which contains high-speed steel tools arranged as seen in the illustration, is mounted on anti-friction bearings.

Howe "Jak-Tung" Truck

The improved "Jak-Tung" truck here illustrated, which has recently been brought out by the Howe Chain Co., 2-30 Clay Ave., Muskegon, Mich., is well adapted for use as a hand truck or trailer



Cleveland Rotary Planer with Hydraulic Carriage Feed

Howe Combination Hand Truck, Trailer, and Storage Unit

Locomotive Type Crane Built by the Silent Hoist Winch & Crane Co.

and for the temporary storage of materials. The body of this truck is made of hard wood or steel, and is shaped to suit the product to be handled. Two rear wheels are permanently attached to the body, as well as a malleable-iron leg at the front. This represents the storage unit.

For use as a hand truck, a "jack tongue" is inserted in the draw-bar as illustrated. To couple several trucks in a tractor train, the jack tongue is removed, and a trailer hitch is inserted in its place. The truck can then be readily coupled to the clevis of the preceding truck.

Union Inserted-Tooth Cutters

Inserted-tooth cutters with high-speed steel blades, serrated at the back and set with taper wedges in front, are being placed on the market by the Union Twist Drill Co., Athol, Mass. The advantage claimed for this method of locking the blades is that there is no give either radially or axially. The blades can be closely adjusted, the radial adjustment range being 1/16 inch.

Fig. 2 shows the design of face milling cutter recommended by the manufacturer for sizes from 4 to 7 inches in diameter. Face mills 8 inches or larger in diameter are designed to be bolted direct to standard spindle noses of milling machines.

"Krane Kar"

A locomotive type crane has been placed on the market by the Silent Hoist Winch & Crane Co., 762-772 Henry St., Brooklyn, N. Y., under the trade name of "Krane Kar." A gasoline engine provides power for raising and lowering loads, swinging them from side to side, and transporting them considerable distances.

The rated capacities of this crane are from 5000 pounds at a five-foot radius to 2500 pounds at a ten-foot radius. Lifting capacities up to 80 per cent greater are available with the boom fixed over the front of the crane.

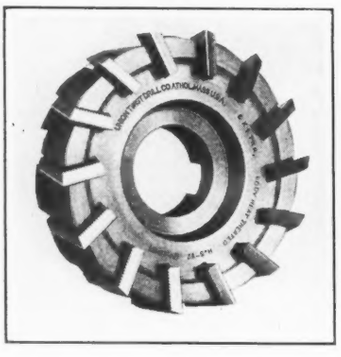


Fig. 1. Union Inserted Serrated-blade Cutter

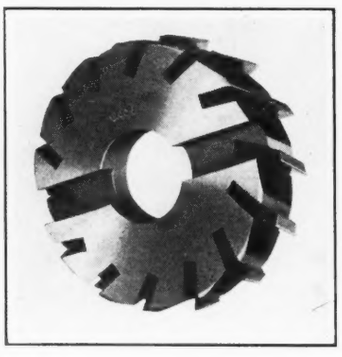


Fig. 2. Face Mill Made in Sizes of 4 to 7 Inches

Cutler-Hammer Explosion-Proof Auto-Transformer Starter

An oil-immersed explosion-proof, auto-transformer automatic starter for alternating-current squirrel-cage motors has been placed on the market by Cutler-Hammer, Inc., 1295 St. Paul Ave., Milwaukee, Wis. Designed to comply with the Underwriters' requirements for Class 1, Group D installations, this starter provides a six-inch head of oil above the contacts. It has an oil-level indicator and an outside spout for replenishing the oil without removing the cover. The terminals are located above the oil level so that the oil will not cause the rubber insulation to deteriorate and produce short circuits.

Elwell-Parker Elevator-Chisel Truck

An electric fork-type lift truck of 6000 pounds capacity is the latest addition to the line of electric trucks built by the

Elwell-Parker Truck of 6000 Pounds Capacity

Clark Tiering Truck with Small Turning Radius

Elwell-Parker Electric Co., Cleveland, Ohio. This truck is constructed to accommodate an electric storage battery or a gasoline-electric unit for power purposes.

The drive wheels are 22 inches in diameter. Forks of various lengths and spreads can be provided to suit sheet metal, castings, forgings, loaded skids, etc. After the forks are thrust under a load, they can be tilted to incline the load sufficiently to carry it safely.

Oliver Pattern Router and Borer

An improved No. 72-DR routing and boring machine recently brought out by the Oliver Machinery Co., Grand Rapids, Mich., will bore holes up to 2 inches in diameter and up to 6 inches in depth, in the center of 36-inch stock at one stroke. The table can be adjusted 12 inches vertically and swivels around a complete circle. It can be tilted 35 degrees in all directions. In addition to boring, the machine can perform milling, routing, light-shaping and recessing operations. It follows closely the design of the No. 72 machine previously described in MACHINERY.

Clark Truck with Four Steering Wheels

A tiering truck that steers with all four wheels, drives from the rear wheels, and is powered with a tractor type gasoline engine capable of twenty-four hours' continuous operation, has been brought out by the Clark Tructractor Co., Battle Creek, Mich. The turning radius is 94 inches, and the truck will negotiate two intersecting 64-inch aisles, with ample clearance on each side. Tiering is accomplished with a hydraulic lift.

Lathes with Gibbs V-Disk Transmission

The General Radial Drill Co., 1767 Elmore St., Cincinnati, Ohio, has recently placed on the market two Schaffner lathes designed primarily for manual training service. The Model B is a metal-working lathe, and the model C, a speed lathe for wood work. Both models employ the patented Gibbs V-disk transmission, and their general construction is much the same.

The Model B machine has a swing of 11 1/4 inches. It is made in 4-, 5-, and 5 1/2-foot lengths, and in bed, bench, and floor types. The head is of an enclosed design, with a built-in motor driving a back cone, as shown in Fig. 2. This cone, in turn, drives the spindle cone through a Gibbs disk mounted as an idler between the cones. The star knob on top of the head is used to control the spindle speeds, six spindle speeds ranging from 67 to 580 revolutions per minute being available. Every bearing in the head is a ball bearing, the spindle running in angular contact bearings which are adjustable for wear.

The Model C lathe has a swing of 12 inches over the bed, and is made in 4-, 5-, 5 1/2-, and 6-foot bed lengths. Two standard

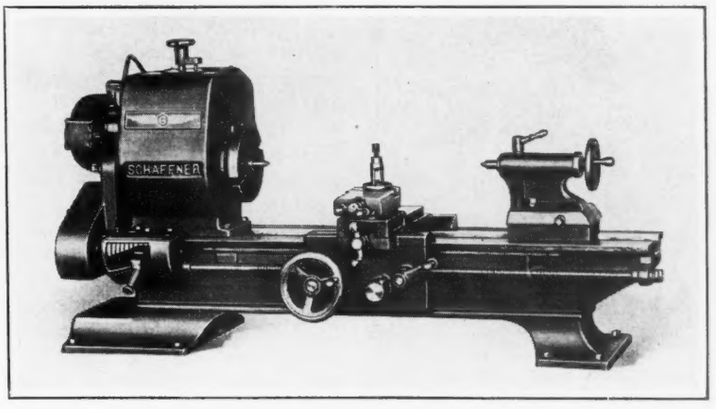


Fig. 1. Bench Lathe with Gibbs V-disk Transmission in Headstock

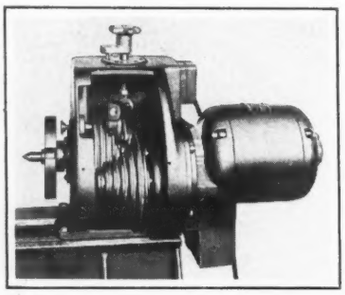


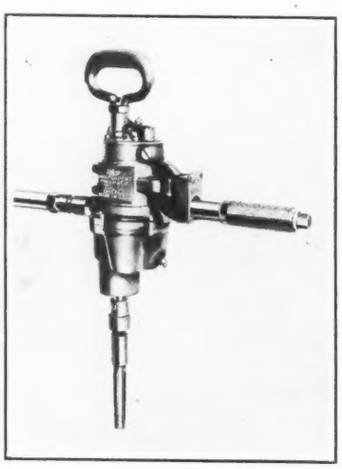
Fig. 2. Arrangement of the Gibbs V-disk Transmission

groups of six spindle speeds each are furnished, ranging from 600 to 3000 revolutions per minute or from 400 to 3400 revolutions per minute.

Thor Air-Driven Tapping and Retapping Tool

The Independent Pneumatic Tool Co., 606 W. Jackson Blvd., Chicago, Ill., has designed a Thor rotary pneumatic drill which is intended primarily for tapping and retapping stud holes, etc., in locomotive boilers. This tool is capable of tapping new holes up to and including 1 inch and retapping holes up to and including 1 1/8 inches. It can also be used for tapping new threads in locomotive cylinder-head castings.

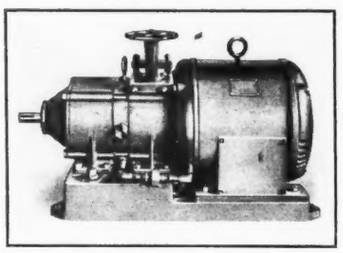
While designed primarily for tapping operations, the tool can also be used for driving or removing nuts, cap-screws, lag screws, etc. It has a speed of 100 revolutions per minute, an over-all length of 14 1/2 inches, and a weight of 19 pounds. One man can handle the tool without assistance.



Thor Air Tool for Tapping and Retapping Stud Holes in Boilers

Electro-Hydraulic Transmission

An electro-hydraulic transmission of compact design has been developed by the American Engineering Co., Philadelphia, Pa., for providing rotary motion at any speed from zero to the maximum. One of the principal advantages claimed is that the transmission will develop the full rated torque at any speed, whether it be 1 or 1000 revolutions per minute. Since the torque is constant, the horsepower output varies with the speed of the hydraulic motor. At maximum speed, the transmission will develop 5 horsepower continuously.



Hydraulic Motor and Pump with Electric Motor Drive

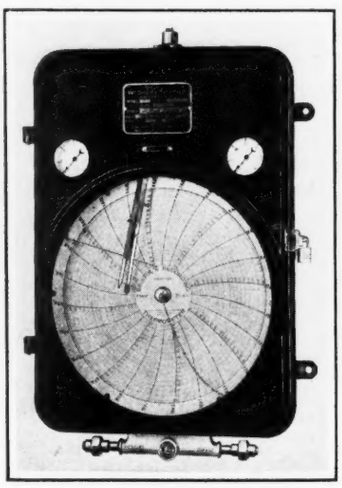
This equipment consists of the hydraulic motor seen at the left in the illustration, the hydraulic pump in the middle, and the electric motor at the right. These units are mounted on a bed which also serves as a reservoir for the oil used in the hydraulic system. The entire transmission, including the electric motor, is 30 inches long, 14 inches wide, and 16 inches high.

The hydraulic pump and motor are of the Hele-Shaw design, and are similar in construction, except that the motor has a fixed stroke, while the stroke of the pump can be varied by means of the handwheel or some other hand or automatic control. Operation of the handwheel governs the amount of oil delivered by the pump to the hydraulic motor. Thus, through the handwheel, the speed of the hydraulic motor can be varied from zero to the maximum in either the forward or the reverse direction.

The electric motor drives the pump shaft at a constant speed. The pump end of the electric motor shaft is fitted with a fan, and the oil used in the system passes through finned tubing which surrounds the fan. This arrangement keeps the temperature of the oil at the proper degree for efficient operation.

Bristol Air-Operated Recorder Controller

A new line of "Free Vane" air-operated, recording controllers is being introduced to the trade by the Bristol Co., Waterbury, Conn. These controllers are suitable for use in connection with tempering baths, solder baths, core ovens, etc. The free vane is employed as the initiator of control. It is attached to and actuated by a measuring element of a temperature or pressure recording system, and moves between two air jets with stream lines coinciding, placed opposite each other. In passing into these air streams, the free vane varies the amount of air that escapes from the jets, thus effecting control.



"Free Vane" Air-operated Recording Controller Made by Bristol Co.

This recorder controller is enclosed in a two-part cast-aluminum base of moisture-proof construction. It is furnished with an inverted pen arm and fountain pen as standard equipment. The chart is rotated by a spring clock or a Bristol Telechron-operated clock. The instrument is furnished with one or two pens. It has a pressure range up to 1500 pounds per square inch and a temperature range up to 1000 degrees F., using 12-inch charts.

Pioneer Multiple-Spindle Drill Heads

A typographical error was made in the statement pertaining to the capacity of the drill heads made by the Pioneer Engineering & Mfg. Co., Inc., 8316 Woodward Ave., Detroit, Mich., as described in September MACHINERY, page 78. This statement read, "Heads can be supplied for drills from No. 60 to 1 1/16 inches in diameter." It should have read, "Heads can be supplied for drills from No. 60 to 2 inches in diameter."

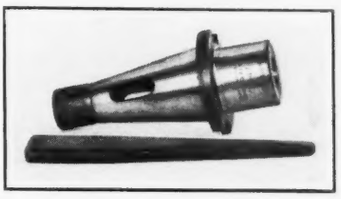
Bodine Vertical Motor with Wool-Packed Bearings

A vertical motor with wool-packed bearings is being placed on the market by the Bodine Electric Co., 2264 W. Ohio St., Chicago, Ill. This motor, which is shown in the accompanying illustration, is available in ratings of 1/10 and 1/8 horsepower at 1725 revolutions per minute, and 1/20 and 1/12 horsepower at 1125 revolutions per minute.

Bodine Vertical Motor of Small Horsepower Rating

B & S Cutter Adapters

Cutter adapters designed for use on milling machines having standardized spindle ends with a No. 40 taper have been added to the line of adapters recently introduced on the market by the Brown & Sharpe Mfg. Co., Providence, R. I. The latest adapters accommodate end-mills, collets, etc., having a No. 3 Morse or Nos. 7 and 9 B & S taper shanks.



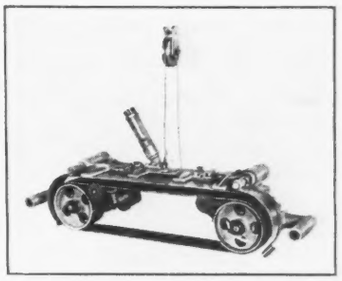
Cutter Adapter for Standard Milling Machine Spindle with No. 40 Taper

At the present time there are few milling machines with the No. 40 standard taper end. The new adapters anticipate plans of machine tool manufacturers to incorporate this taper in machines of small sizes.

Hercules Portable Belt Sander

A Hercules portable belt sander intended for smoothing welds or large steel dies; sanding automobile bodies; finishing metal, wood, and stone surfaces; etc., has been placed on the market by the Buckeye Portable Tool Co., Dayton, Ohio. This equipment, which is shown in the accompanying illustration, will work on flat, concave or convex surfaces, concave surfaces being accommodated by the use of a special attachment.

The sander is suspended over the job by a pulley and cable. It can easily be handled by one man, always being in balance regardless of the position. The equipment is driven by two rotary air motors which develop more than 1 1/3 horsepower each with an air pressure of 85 pounds per square inch. The motors are directly in back of each pulley and are direct-connected.



Hercules Belt Sander which is Suspended over the Work

Howell Adjustable-Shaft Motor

A "Red Band" motor provided with a micrometer adjustment for the shaft has been developed by the Howell Electric Motors Co., Howell, Mich., primarily for the use of pump manufacturers. Through this shaft adjustment, the motor can be adjusted to the maximum capacity of the pump at the maximum efficiency of the motor per horsepower. This can be done in five minutes while the motor is in operation. The shaft adjustment is accomplished by means of a threaded cast-steel housing.

Motor with Micrometer Adjustment for the Shaft

O. K. Tungsten-Carbide Tools

Cutter blades tipped with tungsten carbide have been placed on the market by the O. K. Tool Co., Inc., Shelton, Conn.

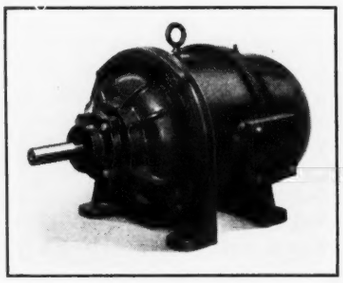
Face Mill with Tungsten-carbide Tools, Made by the O. K. Tool Co., Inc.

These blades are interchangeable with any of the standard cutters made by the concern. Tool bits are available in a variety of shapes for use in O. K. toolholders on lathes, planers, shapers, boring mills, etc.

The illustration shows a face milling cutter with tungsten-carbide blades of the taper serrated construction. Side mills of various types and end-mills are also included in the line, as well as boring and facing heads and hollow mills.

Westinghouse Totally Enclosed Fan-Cooled Motor

A totally enclosed, fan-cooled squirrel-cage motor has been designed by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., to meet the latest specifications of the National Board of Fire Underwriters for use in Class 1, Group D hazardous locations. Free passage of cooling air is insured by providing spaces between the guard and the non-sparking aluminum-alloy fan. The air is kept in constant circulation by fan blades on each end of the rotor.

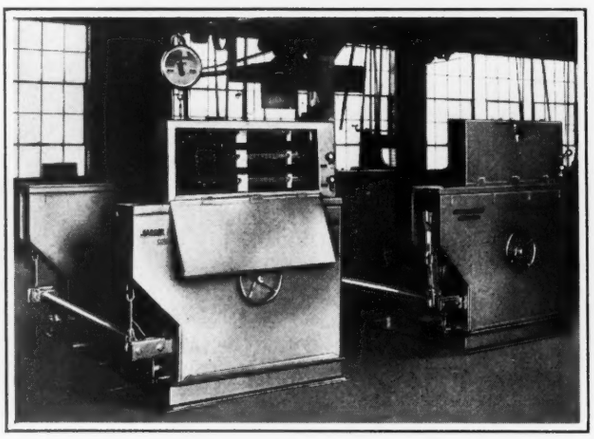


Westinghouse Motor for Use in Hazardous Atmospheres

Arc Welding Extended to the Manufacture of Weighing Scales

An interesting new application for arc welding has been found in the manufacture of a line of weighing scales of the type shown in the accompanying illustration. It is stated that a 40 per cent saving in weight, with accompanying savings in time and production costs, has resulted from redesigning these scales so that the welding method could be applied. This line of scales, manufactured by the Winslow Government Standard Scale Co., is made in capacities of from 500 to 70,000 pounds. Steel plate and structural steel shapes are used both for small standard scales and for larger scales built to order. The cost of making a pattern and casting for special scales is saved; this accounts for part of the savings.

The factory inventory of parts has been greatly reduced by the use of the welding method, since only standard steel shapes are required. In only two places on this scale is material other than rolled steel used; in one case, a steel forging is employed, and in the other, stainless steel. This material is used for the beam indicator, which is welded in position. Even the bosses, lugs, and brackets are made of steel and welded in place; the gears used are also of welded construction.



Weighing Scales of All-welded Construction

School for Teaching Welded Building Design

A school of welding design, the aim of which is to teach engineers, architects, and draftsmen methods of designing welded buildings, has been opened by the General Electric Co. at Schenectady, N. Y. The school is open to men outside of the employ of the General Electric Co., as well as to its own employes. There is no charge for instruction in the course, which requires approximately four weeks for completion. The course is a flexible one and can be adjusted to suit each individual, the only requirement being that the applicant be an engineer or have some training in structural design, or some experience in the design of riveted structures. The need for instruction of this kind has made itself felt more and more, due to the increasing application of welding to buildings.

Who Shall be Master—Man or Machine?

TAMING OUR MACHINES. By Ralph E. Flanders. 244 pages, 5 1/2 by 8 inches. Published by Richard R. Smith, Inc., New York City. Price, $2.50.

A great many books have been written on the machine age by men who do not know much about machines and engineering on the one hand, nor about economics on the other. It is, therefore, a real event to announce that a book has been written on this subject by a man who has an unusually clear grasp of both subjects—a man who recognizes the evils and dangers that are due indirectly to the rapid development of our mechanical civilization, but who also realizes that these difficulties are not inherent in the machine, that they are merely due to the imperfect understanding that we have of the complex economic problems that have arisen during the past half century.

Mr. Flanders is an engineer and the manager of a well-known machine-building plant. He, therefore, comes to this task well equipped. He has placed before us a clear statement of a most vital problem. It is difficult to review this book in such a way as to give an idea of the scope that it covers; the book itself must be read—a brief review could not do it justice. This book is one that every man engaged in industry ought to read. It is a work that will broaden the outlook both of those who find little or no fault with our machine-made civilization and of those who find too much fault with it.

If the keynote of the book could be briefly summarized it would have to be done somewhat as follows: The author points out that, for the first time in the history of mankind, we have reached the point where, in this country at least, we are physically able, by the aid of the machines we have developed, to produce in abundance for all. We have reached the point where we can produce sufficiently so that everyone willing to work may have all the ordinary necessities and comforts of life and quite a few of the luxuries as well.

If everyone does not have all this at the present time—and we know that they do not—it is not the fault of the engineer who has developed the machines nor of the machines themselves. It is because of our lack of understanding of the underlying economic problems; because of our failure to adjust our economic structure, so that the full benefit of our machines may be realized.

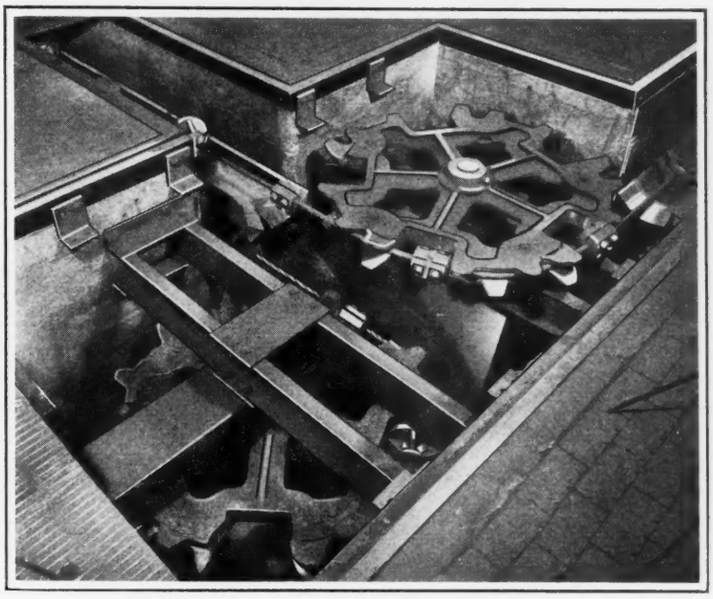
The problem of production has been solved. The problem of how to make production serve its true purpose, that of the well being of all citizens who are willing and able to fill a useful place in the community, this book will aid in solving.

* * *

Chip Conveying System Below Floor Level

The construction of the cross transfer system of the drag cable conveyor used in the plant of the Packard Motor Car Co., Detroit, Mich., for conveying cast-iron chips from the machine tools to a briquetting machine is shown in the accompanying illustration.

A series of these conveyors located below the floor level and at the rear of the machine lines receive the chips from chutes leading directly from the machine. Each line of conveyors delivers its chips to the main conveyor by a cross conveyor of the same type. This system was described by R. R. Rees of the Packard Motor Car Co., in a paper read before the American Society of Mechanical Engineers at Cleveland, Ohio, and also in an article which was published in the September, 1929, number of MACHINERY, page 41.



Transfer Station of Chip Conveyor System

* * *

Roller Bearings for Electric Locomotives

Another step toward the introduction of anti-friction bearings on railway rolling stock has been taken by the Pennsylvania Railroad in ordering Timken roller bearings for 150 new electric locomotives to be built for the Pennsylvania Railroad's electrification project between New York and Washington. This is said to be by far the largest order for anti-friction bearings ever placed by any railroad at one time. Tapered roller bearings will be used for all the engine trucks and the driver wheels.

Of these locomotives, 90 will be for passenger service and 60 for freight. The passenger locomotives are designed for a speed of 90 miles per hour. Formerly, electric locomotives have been equipped with plain bearings.

It will be recollected that two years ago the Timken Roller Bearing Co. built a high-grade steam locomotive equipped with roller bearings—the first locomotive in the world built with anti-friction bearings throughout. This locomotive has now been tested for over a year and a half on eleven railroads. It has traveled over 75,000 miles, and has been handled by over 500 different train crews. Examination shows the bearings to be in as good condition today as when they were placed in service. Considerably over 200 locomotives are equipped at present with roller bearings, either on leading trucks, trailer trucks, or tenders. In addition, they have been applied to several thousand passenger cars and even to freight cars. That the future will see an increasing application of these bearings is certain.

Personals

W. A. FINK has been appointed treasurer of the Toledo Scale Co., subsidiary selling organization of the Toledo Scale Mfg. Co., Toledo, Ohio.

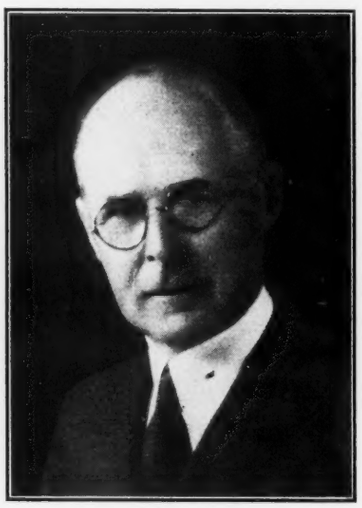
JOHN S. BLEECKER has been appointed manager of sales of Lukenweld, Inc. (division of Lukens Steel Co.), Coatesville, Pa. From 1928 up to his present connection, he has been engaged as a registered professional engineer in industrial and public utility work, specializing particularly in transportation and merchandising.

John S. Bleecker

R. E. FIELD has been appointed manager of the newly opened Chicago office of the Cincinnati Milling Machine Co. and the Cincinnati Grinders, Inc., located in the Chicago Daily News Building, 400 W. Madison St. Mr. Field is a graduate of the University of Cincinnati, and has worked in the Chicago, Cincinnati, and Pacific Coast territories as sales engineer for the Cincinnati Milling Machine Co. during the last twelve years.

R. E. Field

FRANK J. TONE, president of the Carborundum Co., Niagara Falls, N. Y., has been selected as the first winner of the Jacob F. Schoellkopf gold medal of the Western New York Section of the American Chemical Society. The medal is given for achievements constituting a major advance in science and industry, especially in the field of research. The outstanding contributions of Mr. Tone, as cited by the Jury of Award, include his work, with the late F. A. J. Fitzgerald, on the properties and commercial applications of silicon carbide, the production of pure metallic silicon, and the industrial application of electrochemistry. The medal was presented at a national gathering of scientists held in Buffalo, September 2.



Frank J. Tone

J. E. CASTER has been appointed manager of the newly opened Cleveland office of the Cincinnati Milling Machine Co. and the Cincinnati Grinders, Inc., located at 5005 Euclid Ave., Cleveland, Ohio. Mr. Caster is a graduate of Purdue University. In 1916, he became affiliated with the Cincinnati Milling Machine Co. as tool designer and engineering specialist. In 1925 he was transferred to the Cincinnati Grinders, Inc., and has since 1929 been assistant sales manager of that company.

J. E. Caster

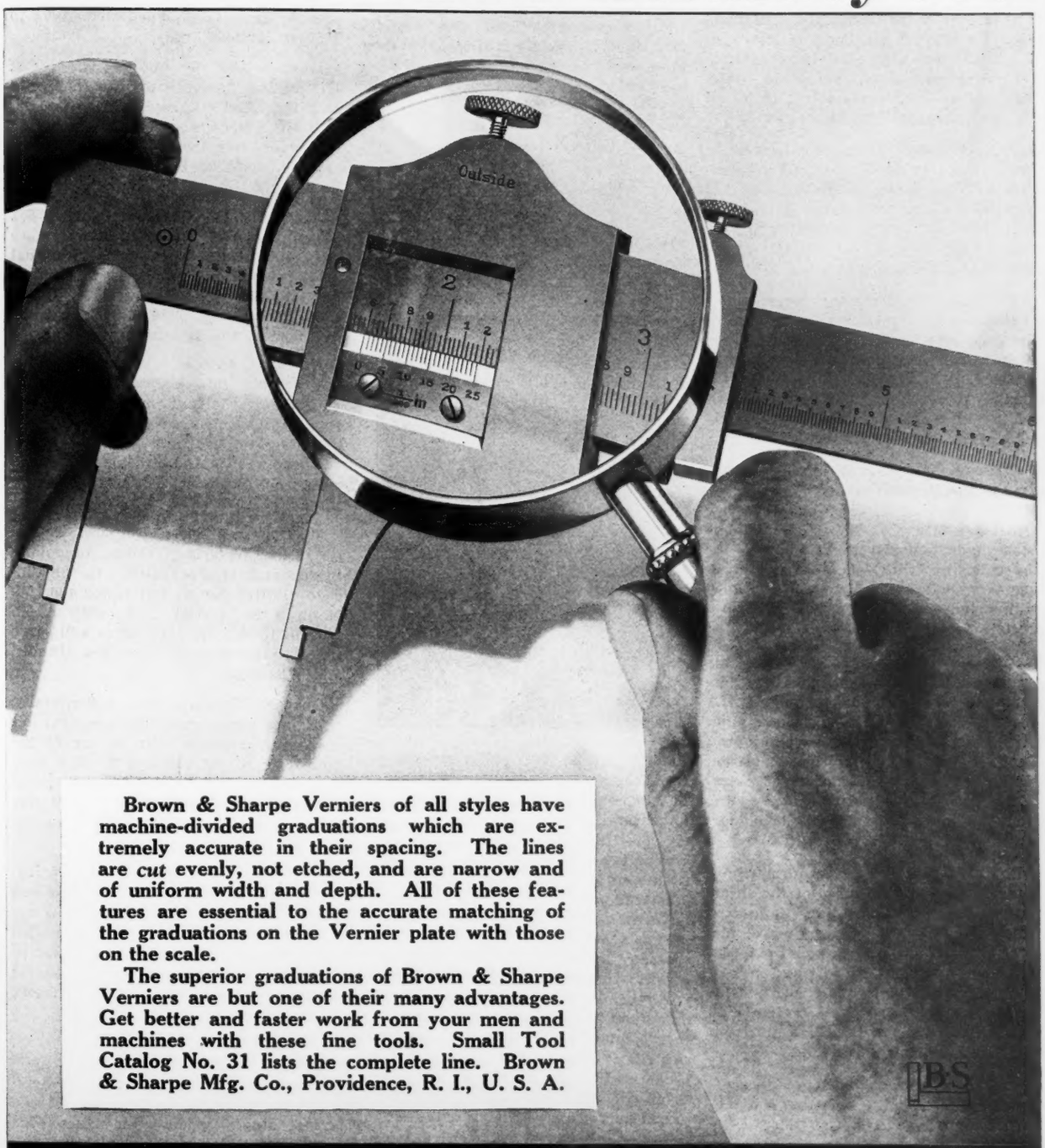
EDMUND E. BURKE, who for the last eight years has been engaged in special sales and engineering work with the Kent-Owens Machine Co., Toledo, Ohio, manufacturer of hand milling machines and special machinery, has been made sales manager, covering both divisions of the company's operations. A special service department has been inaugurated in connection with other development work of the company, which will be under the charge of HAROLD STEVENS.

Edmund E. Burke

S. E. BERGSTROM has been appointed manager of the newly opened Detroit office of the Cincinnati Milling Machine Co. and the Cincinnati Grinders, Inc.,

S. E .Bergstrom

Fine, Clean-Cut Lines mean Accuracy . . .



Brown & Sharpe Verniers of all styles have machine-divided graduations which are extremely accurate in their spacing. The lines are *cut* evenly, not etched, and are narrow and of uniform width and depth. All of these features are essential to the accurate matching of the graduations on the Vernier plate with those on the scale.

The superior graduations of Brown & Sharpe Verniers are but one of their many advantages. Get better and faster work from your men and machines with these fine tools. Small Tool Catalog No. 31 lists the complete line. Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.

Brown & Sharpe

- Over 2300 Good Tools -

located in the New Center Building, Detroit. Mr. Bergstrom is a graduate of Purdue University. After having been employed by the Buick, Dodge, and Nash Motor companies, he became associated, in 1925, with the National Automatic Tool Co. as Chicago representative. Since 1927 he has been automotive milling specialist for the Cincinnati Milling Machine Co.

R. B. KITE has been appointed manager for the Philadelphia territory of the Hoist and Crane Division of Robbins & Myers, Inc., Springfield, Ohio. Mr. Kite will be located at 401 N. Broad St., Philadelphia, Pa.

C. B. COLDWELL, formerly located in the Chicago office of the International-Stacey Corporation, Columbus, Ohio, is now in charge of the sales of the company's Roots-Connersville-Wilbraham Division line at the Fort Worth, Texas, office, located at 1309 Aviation Bldg.

W. C. BRUTON, for many years a sales engineer in the Oakland, Calif., office of the American Manganese Steel Co., Inc., Chicago Heights, Ill., has been appointed district sales manager for the Pacific northwest territory. Mr. Bruton will make his headquarters at the Seattle office, 411 Colman Building.

CHARLES M. GEARING, division manager of the Meriden plant and a member of the board of directors of the New Departure Mfg. Co., Bristol, Conn., has been made general works manager of the company, with offices at the headquarters in Bristol. Mr. Gearing's duty will include general supervision of production in all the plants.

OTTO NONNENBRUCH, for the last four years chief engineer of the Diesel department of I. P. Morris and De La Vergne, Inc., Philadelphia, Pa., and prior to that with the Worthington Pump & Machine Corporation, Harrison, N. J., has rejoined the latter organization as special sales representative. Mr. Nonnenbruch will make his headquarters at Buffalo, N. Y.

B. T. EHRNMAN, who was formerly located in the Chicago office of the International-Stacey Corporation, Columbus, Ohio, manufacturer of gas pumps, meters, blowers, oil and gas drilling and pumping equipment, airport and airway equipment, and electrical equipment, has been transferred to St. Louis as division manager, with offices at Room 2192, Railway Exchange Bldg.

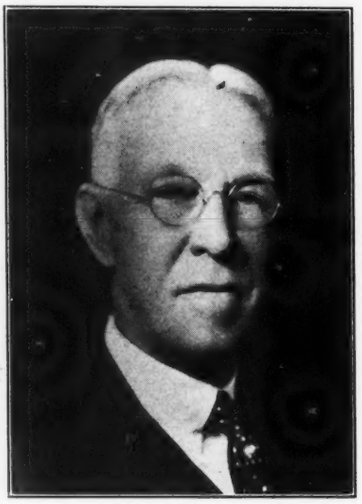
A. C. STREAMER, for some years assistant director of sales with the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has been appointed sales manager of the newly created diversified products sales department in which is grouped all Westinghouse equipment not allied with the transportation, central station, and industrial fields.

ERNST BERNDT, president of Schiess-Defries A. G., Düsseldorf, Germany, arrived in the United States, September 10, with the object of visiting the more important industrial centers here and investigating the possibilities for the sale of heavy machine tools and special machines of types that are not generally built in the United States. He expects to remain in this country until the latter part of October. During his stay here, he can be reached at the company's American office, 702 Fountain Square Bldg., Cincinnati, Ohio. Mr. Berndt's firm employs, in normal times, 3000 men, in addition to an engineering and office force of 400.

Obituaries

Harry Phillips Davis

Dr. Harry Phillips Davis, vice-president and director of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., and chairman of the National



Broadcasting Co., died in Pittsburgh, Pa., September 10, after an illness lasting several months. Dr. Davis was born in New Hampshire in 1868. He was a graduate of Worcester Polytechnic Institute, and became associated with the Westinghouse organization in 1891. For more than twenty-one of the forty years during which he was connected with the company he was in charge of the engineering department, and for fifteen years he directed the engineering and manufacturing operations. Among his early achievements was his work in the electrification of the New York, New Haven & Hartford Railroad. His ability as an executive was on a par with his record as a creative design engineer.

VAN NESS DELAMATER, who has been with the Hyatt Roller Bearing Co., Newark, N. J., since 1915, disappeared, with his son, while on a canoe trip on Green Lake, Ontario, August 29, and is believed to have lost his life in a storm. He was a graduate of Cornell University, class of 1900.

News of the Industry

TOOL EQUIPMENT SALES CO., announces a change of address from 18 S. Clinton St., Chicago, Ill., to 4625 Fulton St., Chicago.

WESSON SALES CO., Detroit, Mich., announces that the name of the company has been changed to WESSON CO. It is also announced that the company has moved from 7338 Woodward Ave. to 1050 Mt. Elliott Ave.

EASTON CAR & CONSTRUCTION CO., Easton, Pa., has acquired the Industrial Division of the Lakewood Engineering Co. Hereafter the complete line of Lakewood tier trucks, electric trucks, trailers, skids, and industrial cars will be manufactured at Easton, Pa.

ALLEN-BRADLEY CO., 1331 S. First St., Milwaukee, Wis., manufacturer of electric control apparatus, held its annual sales convention August 24 to September 1 at Sherwood Forest Hotel, Green Lake, Wis., with F. F. Loock, general manager of the company, presiding.

NATIONAL ACME CO., Cleveland, Ohio, has entered into a license agreement with the Dardelet Threadlock Corporation, 120 Broadway, New York City, to manufacture, use, and sell bolts, nuts and screw machine products threaded with the Dardelet self-locking screw thread.

WATERBURY FARREL FOUNDRY & MACHINE CO., Waterbury, Conn., announces the opening of a sales office in the Chicago Daily News Building, 400 W. Madison St., Chicago, Ill., with A. R. Nichols in charge. This office will serve the Chicago district, northern Illinois, and Wisconsin.

GENERAL ELECTRIC CO., Schenectady, N. Y., announces that the largest exhibit space yet contracted for in any of the buildings of the Chicago World's Fair to be held in 1933 has been leased by the company. An area of 9000 square feet will be devoted to a display of General Electric products.

ROBBINS & MYERS SALES, INC., Springfield, Ohio, announce that the hoist and crane division of the company has appointed the W. P. & R. S. Mars Co., Duluth, Minn., exclusive representative for the sale of Robbins & Myers electric hoists and cranes in northern Minnesota and the upper Michigan peninsula.

CITY MACHINE & TOOL WORKS, Dayton, Ohio, sends a news item well worth publishing in these days when such cheerful news is rather rare. Two of the largest single orders ever placed for gear chamfering and burnishing machines have recently been received from two prominent automotive manufacturers, each order being for 17 machines, or 34 machines in all.

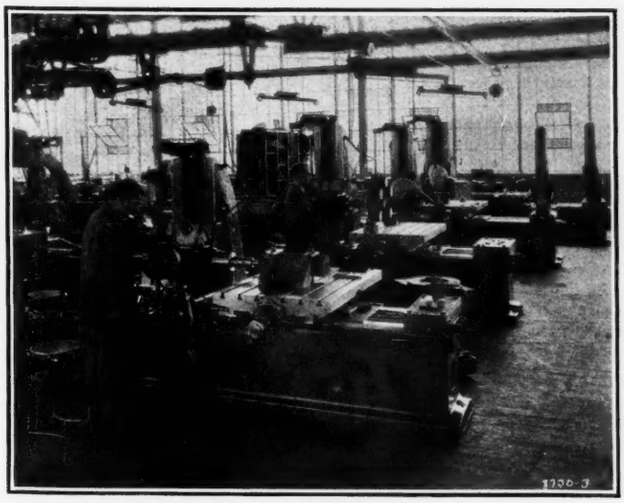
LEAVITT MACHINE CO., Orange, Mass., has purchased the separator business from the Swendeman Corporation,

Profit by Experience of Others

Repeat orders extending over a period of years give the best of evidence of satisfactory service on most exacting work.

The Cuts Show Only 8 of the 9

Lucas



"PRECISION" HORIZONTAL BORING MACHINES

in the fine shop of a prominent Detroit concern making jigs, fixtures, drill heads and aircraft engine parts.

The ninth LUCAS has been installed in this shop since these pictures were taken.

You will make no mistake in putting a "LUCAS" in your shop now.

Ask for Circular A-45, giving details regarding the latest type machines, made in 3″, 4″ and 5″ spindle sizes.

THE LUCAS MACHINE TOOL CO., Cleveland, Ohio

FOREIGN AGENTS: Allied Machinery Co., Barcelona, Zurich. Andrews & George Co., Tokyo. Catmur Machine Tool Corp., Ltd., London, Eng. M. Kocian & G. Nedela, Prague. V. Lowener, Copenhagen, Oslo, Stockholm. Emanuele Mascherpa, Milan, Italy. R. S. Stokvis & Zonen, Rotterdam, Paris.

Boston, Mass., and will continue to manufacture and sell Swendeman separators and drains for compressed air lines. Mr. Swendeman has become associated with the Leavitt Machine Co., and problems relating to the separation of moisture from compressed air lines will be referred to him.

FARREL-BIRMINGHAM CO., INC., 377 Vulcan St., Buffalo, N. Y., has opened a new office in Chicago, Ill., at 1059 First National Bank Bldg., Monroe and Clark Sts. Harry Temporal, formerly connected with the Akron office, will have charge of the new office. Mr. Temporal has been a sales representative of the company for twenty-one years. The Akron office, of which Andrew Hale is in charge, has been removed from the United Building to 2710 Central Depositors Bank Building.

NITRALLOY CORPORATION, 230 Park Ave., New York City, which owns and controls various patents covering the process of nitriding, composition of alloy steels and cast irons, and furnaces, has, in conjunction with the Electric Furnace Co., Salem, Ohio, which company holds a furnace license from the Nitralloy Corporation, and the Commercial Steel Treating Co., Detroit, Mich., placed in operation a demonstration nitriding center in the latter company's plant at 6100 Tireman Ave., Detroit. The need for such a demonstration plant in the Detroit district has long been recognized, and the present installation will give manufacturers in the Detroit district an opportunity to investigate the nitriding process more thoroughly.

Coming Events

OCTOBER 7-8—Production meeting of the Society of Automotive Engineers at the Book-Cadillac Hotel, Detroit, Mich. R. S. Burnett, Director, Production Activity, 29 W. 39th St., New York City.

OCTOBER 12-16—Twentieth Annual Safety Congress and Exposition to be held at the Stevens Hotel, Chicago, Ill. For further information, apply to the National Safety Council, 20 N. Wacker Drive, Chicago.

OCTOBER 12-16—Thirteenth annual convention and exhibition of the American Gas Association at Atlantic City, N. J. For further information, address J. B. Nealey, American Gas Association, 420 Lexington Ave., New York.

OCTOBER 13-16—Twenty-fifth annual convention of the Illuminating Engineering Society at the William Penn Hotel, Pittsburgh, Pa. For further information, apply to the secretary, Illuminating Engineering Society, 29 W. 39th St., New York City.

OCTOBER 14-16—Eighteenth national convention of the Society of Industrial Engineers to be held at the Fort Pitt Hotel, Pittsburgh, Pa. Secretary's office, 205 W. Wacker Drive, Chicago, Ill.

OCTOBER 15-16—Fourth annual convention of the Gray Iron Institute at the West Baden Springs Hotel, West Baden Springs, Ind. Manager, Arthur J. Tuscany, Terminal Tower Bldg., Cleveland, Ohio.

OCTOBER 15-17—Semi-annual meeting of the American Gear Manufacturers' Association to be held at the William Penn Hotel, Pittsburgh, Pa. T. W. Owen, secretary, 3608 Euclid Ave., Cleveland, Ohio.

OCTOBER 27-29 (date changed from NOVEMBER 10-12)—National Transportation Meeting of the Society of Automotive Engineers at the Shoreham Hotel, Washington, D. C. Robert S. Burnett, Director, Transportation and Maintenance Activity, 29 W. 39th St., New York City.

NOVEMBER 30-DECEMBER 4—Annual meeting of the American Society of Mechanical Engineers at the Engineering Societies' Building, 29 W. 39th St., New York City. Calvin W. Rice, secretary, 29 W. 39th St., New York.

New Books and Publications

VOLTAGE RELATIONS AND LOSSES IN SMALL UNIVERSAL MOTORS. By A. F. Puchstein and Ivor S. Campbell. 27 pages, 6 by 9 inches. Published by the Ohio State University, Columbus, Ohio, as Bulletin No. 58 of the Engineering Experiment Station. Price, 50 cents.

A MULTIPLE MANOMETER AND PISTON GAGES FOR PRECISION MEASUREMENTS. By C. H. Meyers and R. S. Jessup. 42 pages, 6 by 9 inches. Published by the U. S. Department of Commerce, Washington, D. C., as Research Paper No. 324 of the Bureau of Standards. Price, 10 cents.

THE INFLUENCE OF CHEMICAL COMPOSITION AND HEAT-TREATMENT OF STEEL FORGINGS ON MACHINEABILITY WITH SHALLOW LATHE CUTS. By T. G. Digges. 16 pages, 6 by 9 inches. Published by the U. S. Department of Commerce, Washington, D. C., as Research Paper No. 319. Price, 10 cents.

TECHNICAL WRITING. By T. A. Rickard. 337 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York City. Price, $2.

This is the third edition of a book prepared especially for the writer of technical articles. The original material for this book was based on a set of five lectures delivered before the engineering classes of the University of California. In the second edition several additions were made, including a chapter entitled "The Wrong Word" and one on punctuation. The third edition is substantially the same as the second, with several slight corrections.

SHOP ARITHMETIC. By Earle B. Norris and Kenneth G. Smith. 271 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City. Price, $2.

This is the third edition of the first part of a work on shop mathematics prepared in the Extension Division of the University of Wisconsin. The aim of the book is to teach the fundamental principles of mathematics to shop men, using familiar terms and processes and giving such applications to shop problems as will maintain the interest of the student and develop in him an ability to apply the mathematical and scientific principles to everyday shop problems. The problems and applications relate largely to the metal-working trades, but will also be found of value to those in other lines of industry.

HENLEY'S TWENTIETH CENTURY RECIPES, FORMULAS, AND PROCESSES. Edited by Gardner D. Hiscox. 809 pages, 6 by 9 inches. Published by the Norman W. Henley Publishing Co., 2 West 45th St., New York City. Price, $4.

This is a revised edition of a popular book containing ten thousand household, work-shop, and scientific formulas and chemical recipes. The new edition contains many new formulas in keeping with the rapid advances taking place in industry today. Special attention has been given to methods that have recently revolutionized the paint industry, and many recipes have been included on paints, lacquers, and varnishes and their proper application. Another addition to the book relates to chromium plating. There is also a chapter on laboratory methods, giving instructions for compounding recipes. In order to assist users who are not in close touch with commercial centers, a classified buyers' guide has been placed in the front of the book for handy reference.

MACHINE SHOP PRACTICE LABORATORY MANUAL. By Alexander P. Gwiazdowski. 57 pages, 6 by 9 inches. Published by Barc Bros., 2200 E. Forest Ave., Detroit, Mich.

The author of this book, who is assistant professor of shop practice in the colleges of engineering and architecture at the University of Michigan, has prepared this book especially for the teaching of shop practice in colleges. The method of presenting the subject is unusually concise, and in planning the course the author has particularly taken into consideration the fact that a knowledge of shop practice aids in studying mechanical drawing and machine design. Important preliminary instructions are included, the most commonly used tools are illustrated and described, shop terms are defined, and the student is started off with a knowledge of fundamentals. Too often students are hampered by being started at work without sufficient preliminary instruction. Specific operations, with carefully planned operation sheets, then follow.

MAC RAE'S BLUE BOOK (1931-1932). 3111 pages, 8½ by 11 inches. Published by MacRae's Blue Book Co., 51 Madison Ave., New York City. Price, $15.

This is the thirty-ninth edition of a comprehensive commercial register covering all manufactured products in the United States and Canada. The present edition follows the same arrangement as the previous ones, the first section containing an alphabetical list of manufacturers, producers, and wholesalers, including in many cases the addresses of branch offices. The second section contains an index of products, or finding list. The third or main part of the book is the classified material section, which contains a list of the manufacturers classified according to their products. The Canadian section follows the classified material section, and is followed, in turn, by the trade facilities section, which lists the towns having a present estimated population of 1000 or more, and gives the leading commercial body with the name of the secretary, the leading bank, and the name of the cashier, names of all railroads, and the names of storage and distributing warehouses. Airports and flying fields are also indicated. All the sections of the book are printed on different colored paper for ready reference. This directory will be found an invaluable aid in locating sources of supply and compiling mailing lists.

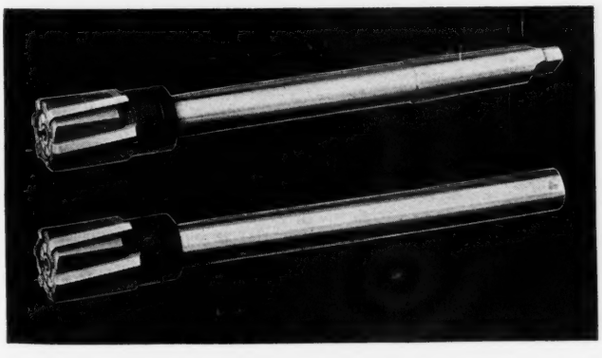
WETMORE

ADJUSTABLE REAMERS

The praise and respect of the men in the shop—those who use reamers daily and know their performance—is the greatest tribute. It is significant that Wetmore Adjustable Reamers have earned the preference of skilled craftsmen in every industry. Wetmore is known to them as "THE BETTER REAMER" from all standpoints—precision, finish, long life, economy. To you who *buy* reamers, what more convincing proof could there be than this endorsement of men who have used Wetmore Reamers for many years? . . . Send for latest catalog of all types of Wetmore Adjustable Machine and Cylinder Reamers and replacement blades.

WETMORE REAMER COMPANY

412 No. 27TH ST. MILWAUKEE, WISCONSIN



WETMORE

TYPE NO. 10 STANDARD REAMERS

Left-hand angle blades—high-speed steel, hardened and ground — insure free cutting at all times. Adjustments to .001 inch made rapidly and accurately. Micrometer adjusting screw is at front end of reamer body. Adjustable in less time than ordinary reamers. Oversize adjustment insures long life for each set of blades. Solid alloy steel body is heat-treated. Sizes range from 1" to 3" inclusive.

New Catalogues and Circulars

ELECTRICAL EQUIPMENT. Electric Controller & Mfg. Co., Cleveland, Ohio. Circular announcing a new size Type ZO motor starter.

PRESSES. John Robertson Co., Inc., 123-131 Water St., Brooklyn, N. Y. Leaflet illustrating and describing presses for lead-encasing rubber hose.

WELDED MACHINERY BASES. Lincoln Electric Co., Cleveland, Ohio. Application sheet No. 22, Series 2, containing data on the design of welded machinery bases.

SPEED REDUCERS. W. A. Jones Foundry & Machine Co., 4401 Roosevelt Road, Chicago, Ill. Circular giving ten advantages of the Jones herringbone speed reducers.

MOTOR-DRIVE BASE. Kritzer Co., 515 W. 35th St., Chicago, Ill. Data book giving specifications, applications, and dimensions of the Kritzer floating motor-drive base.

AIR COMPRESSORS. Quincy Compressor Co., Quincy, Ill. Bulletin 10-A, illustrating and describing the Quincy service-station type automatic two-stage air-cooled compressor.

INSULATION MATERIAL. American Lava Corporation, Chattanooga, Tenn. Catalogue 32, announcing lava and magnesia specialty insulation for mechanical and electrical uses.

HEAT-TREATING EQUIPMENT. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa. Bulletin containing data on an improved potentiometer pyrometer known as the "Micromax."

OIL AND WATER SEPARATORS. Leavitt Machine Co., Orange, Mass. Circular descriptive of the Swendeman separator, an automatic device that eliminates oil and water from compressed air lines.

BEARING COMPENSATORS. Wyrick Engineering Co., Wyandotte, Mich. Bulletin 102, entitled "Simplified Spindle and Bearing Mounting Designs," descriptive of WYR-omat-ICK compensators for machine bearings.

BALL AND ROLLER BEARINGS. Aetna Ball Bearing Mfg. Co., 4600 Schubert Ave., Chicago, Ill. Circular entitled "Finding Your Bearings?," announcing a handbook on ball and roller bearings for designers and engineers.

MOTORS. Century Electric Co., 1806 Pine St., St. Louis, Mo. Circular illustrating and describing Century repulsion start induction single-phase motors, which are suitable for all kinds of constant-speed motor applications.

BLOWERS AND PUMPS. International-Stacey Corporation, Columbus, Ohio. Bulletins 22-B-10, 23-B-10, and 32-B-10, describing, respectively, R-C-W standard-duty blowers; heavy-duty blowers; and standard-duty gas pumps.

MATERIAL-HANDLING EQUIPMENT. Cleveland Electric Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio. Circular showing applications of the Cleveland overhead tramrail system in the foundry industry.

WELDING EQUIPMENT. General Electric Co., Schenectady, N. Y. Bulletin GEA-995B, entitled "Arc Welding in Industry," showing various applications of arc-welding equipment. Bulletin GEA-1440, illustrating and describing G-E arc welders.

ELECTRICALLY HEATED TANKS. H. O. Swoboda, Inc., 3400 Forbes St., Pittsburgh, Pa. Bulletin 230, illustrating and describing Falcon electrically heated melting and coating tanks suitable for oils, compounds, varnishes, and similar materials.

PROTECTIVE COATINGS. Liquilox Co., Ltd., 576 Subway Terminal Bldg., Los Angeles, Calif. Circular outlining the properties and application of "Liquilox," a protective coating that resists the action of acids, heat, fire, alkalies, salts, and water.

BEVEL GEARS AND GEAR GENERATORS. Gleason Works, 1000 University Ave., Rochester, N. Y. Circular giving information on the manufacture of straight bevel gears and the construction and operation of machines for generating them.

PNEUMATIC TOOLS. Cleveland Pneumatic Tool Co., and Cleveland Rock Drill Co., manufacturers of pneumatically operated tools, machinery, and accessories, have issued a catalogue in the French language, covering the hundreds of products made by the two companies.

MOTORS. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Leaflet 20,525, describing a new mill motor, which is designed for heavy-duty applications, such as steel mill auxiliary drives, cranes, hoists, shovels, railway turntables and lift bridges, conveyors, etc.

GAS CUTTING MACHINES. General Welding & Equipment Co., 70 Lansdowne St., Boston, Mass. Pamphlet on machine cutting, treating of the main fields of machine cutting; heat effects of the process; limitations of the cutting process; gases for cutting; cost of machine cutting; and automatic cutting machines.

INDICATING, RECORDING, AND CONTROLLING INSTRUMENTS. C. J. Tagliabue Mfg. Co., Park and Nostrand Aves., Brooklyn, N. Y. General catalogue containing 100 pages covering the complete line of Tag controllers, recorders, dials, thermometers, hydrometers, oil-testing instruments, and moisture meters.

SILENT GEARS. Continental-Diamond Fibre Co., Newark, Del. Catalogue describing Celoron silent gears and showing various applications of these gears. The catalogue also contains a section of gear information giving horsepower rating and tables for calculating safe working stresses, as well as tables of gear-tooth data.

GEARS. Earle Gear & Machine Co., 4709 Stenton Ave., Philadelphia, Pa. Catalogue 31, containing illustrations, tables, engineering data, and formulas relating to metallic and non-metallic gears, racks, sprockets, sheaves, and speed reducers. The catalogue also contains a section on bridge-operating machinery.

PLASTIC PRODUCTS. General Electric Co., Schenectady, N. Y. Bulletin entitled "Plastic Products," illustrating various applications of Textolite, Fabroil, and Cetec products. Bulletin GEA-1456, 1457, and 1458, dealing, respectively, with the properties, construction, and uses of Cetec, Textolite molded, and Textolite laminated.

FITTINGS. Midwest Piping & Supply Co., Inc., 1450 S. 2nd St., St. Louis, Mo. Circular illustrating and describing Midwest welding fittings. These are welded fittings intended for use where the fittings, in turn, may be welded to the pipe lines. Welding saddles for use at the junction of the neck and body of a welded header are also available.

TOOL-ROOM LATHES. Lodge & Shipley Machine Tool Co., Cincinnati, Ohio. Catalogue illustrating and describing in detail the construction of Lodge & Shipley 12- and 14-inch tool-room lathes. Tables of standard ranges of threads, leads, and feeds are given, and complete specifications for the selective-head and cone-head types are included.

SPEED REDUCERS. Universal Gear Sales Corporation, Indianapolis, Ind. Catalogue of heliocentric speed reducers, a speed reducer based on a different principle from that used in other types of reducers. The principle of design is described in the catalogue, and data on the complete line of single-, double-, and triple-stage speed reducers is included.

THREADING TOOLS. Geometric Tool Co., New Haven, Conn. Booklet dealing with Geometric Class S collapsing taps, which are designed in capacities for internal threading jobs from 1 1/4 to 8 1/2 inches in diameter. The booklet includes, in addition to a concise description of these taps, several examples of unusual adaptations to special work.

BALL BEARINGS. New Departure Mfg. Co., Bristol, Conn. Eighth edition of the New Departure Price and Data Book, covering the line of ball bearings made by this concern. The new edition contains important revisions and additions to previous listings of types, capacities, dimensions, and mounting details. It is provided with a thumb-index for convenient reference.

COLD-FINISHED BARS. Joseph T. Ryerson & Son, Inc., Chicago, Ill. Bulletin A, describing the wide variety of shafting, screw stock, and open-hearth case carburizing steels carried in stock by this company and the uses for which they are most suited. The last page of the pamphlet gives standard manufacturing tolerances and S A E specifications for steel bars.

TUNGSTEN-CARBIDE TOOLS. Metal Carbides Co., 361-367 Jelliff Ave., Newark, N. J. Catalogue 31-7, descriptive of standard general-purpose tools and blanks made from "Talide"—a tungsten-carbide metal which is produced in two grades. Tables giving the dimensions of the various styles of tools and the standard tool numbers for convenience in ordering are included. Price sheets for these tools have also been issued.

LATHES. South Bend Lathe Works, 727 E. Madison St., South Bend, Ind. General catalogue 92, containing 128 pages covering the South Bend Series O line of lathes from the 9- to the 18-inch size. The catalogue contains descriptions, illustrations, and prices of the various sizes. Special attention is called to the new underneath-belt motor-driven lathe, which is obtainable both in tool-room and general-purpose types.

HYDRAULIC EQUIPMENT. Baldwin-Southwark Corporation, Philadelphia, Pa. Bulletin 25, containing tables and data compiled especially for those engaged in the design or use of hydraulic equipment. Among the data presented are tables of capacities of hydraulic rams; plunger displacement; properties of various sections; beam formulas; method of finding moment of inertia of an irregular area; water-transmitting capacity of pipes; data on accumulators, pumps, intensifiers, and shock valves; and many other tables and diagrams. Several sheets of cross-section paper are bound in the book for convenience in making notes.

ELECTRIC EQUIPMENT. General Electric Co., Schenectady, N. Y. Circulars GEA-67B, 137B, 699, 708B, 712A, 938B, 1184A, 1404, 1406, 1420, 1430, and 1450, describing, respectively, float switches for use with automatic pumping equipment; low-speed synchronous motors; G-E "Thrustor," an electric device intended to replace hand-levers for machine operation or wherever a smooth powerful thrust is required; 7600 series synchronous motors; indoor bus supports; switchgear accessories; magnetic switches; directional distance relays; explosion-proof fan-cooled single-phase motors; time meters; air circuit breakers; and magnetic drive turbines.